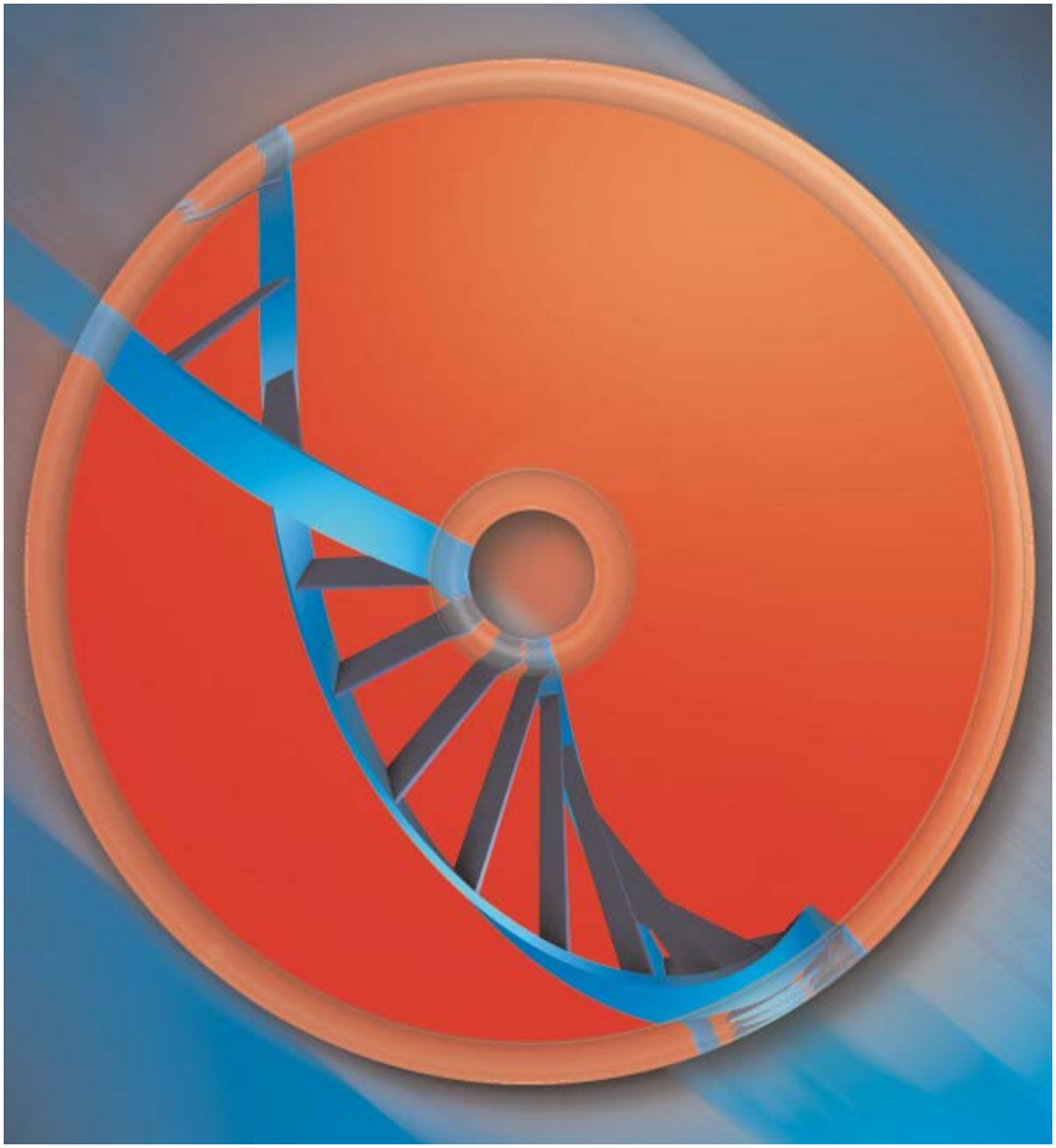
MAGAZINE
Lab Manager®
Where Science and Management Meet™

February 2007 Volume 2 • Number 2



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TIME	MARKET FOCUS	TOPIC	SPEAKER
Monday, February 26			
10:00 am	Hydrocarbon Processing	An Overview of Biodiesel Analysis: Biodiesel Solutions	**D. Armstrong**
10:30 am	Environmental	An Overview of Speciated Inorganic Analysis in Water	**Z. Grosser**
11:00 am	Pharmaceutical	Thermal Analysis for Lyophilized Pharmaceuticals	**F. Summers/K. Menard**
1:30 pm	Forensic	FT-IR Spectroscopy Tools for Forensic Trace Analyses	**S. Williams**
2:00 pm	Forensic	Glass and Other Trace Characterization using LA/ICP-MS	**C. Schneider**
2:30 pm	Service – One Source	Proven Approaches to Controlling Maintenance Spend and Enhancing Lab Productivity	**M. Long**
Tuesday, February 27			
9:30 am	Hydrocarbon Processing	Determine Total Base Number (TBN) values automatically and rapidly using FT-IR	**D. Hilligoss**
10:00 am	Environmental	Headspace Trap GC, Alternative to Purge and Trap for VOC Analysis	**M. Collins**
10:30 am	Forensic	Improved Precision in Headspace Blood Alcohol Analysis	**T. Ruppel/M. Collins**
11:00 am	Hydrocarbon Processing	LIMS and Hydrocarbon Processing: Turning Laboratory Data into Information Usable by the Enterprise in Timely Manner	**J. Nobles**
1:30 pm	Food and Beverage	Inorganic Analysis for Food Safety and Quality	**Z. Grosser**
2:00 pm	Pharmaceutical	Routine Screening with Chromatographic Techniques to Ensure Quality	**M. Collins**
2:30 pm	Service – One Source	Proven Approaches to Controlling Maintenance Spend and Enhancing Lab Productivity	**D. Tenney**
Wednesday, February 28			
9:30 am	Food and Beverage	Pesticides and Organic Chemical Monitoring in Food and Beverage, Ensuring our Food Safety	**M. Collins**
10:00 am	Environmental	LIMS Plus Wireless PDAs Help Wastewater Plant Save Time, Increase Accuracy	**M. Lehtola**
10:30 am	Pharmaceutical	IR and NIR Imaging of Pharmaceutical Tablets	**S. Williams**
11:00 am	Pharmaceutical	Raman Spectroscopy: from Drug Discovery to PAT	**A. Dennis**
1:30 pm	Hydrocarbon Processing	The Advantage of Advanced GC Gas Control for Refinery Analyses	**D. Armstrong/C. Wentzel**
2:00 pm	Environmental	Meeting the Needs for Water and Environmental Analysis with UV/Vis Spectroscopy	**C. Lynch**
2:30 pm	Service – One Source	Proven Approaches to Controlling Maintenance Spend and Enhancing Lab Productivity	**M. Long**

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Author Guidelines

Lab Manager Magazine® is a printed publication of resources, products, and information for today's laboratory manager. Articles should address some aspect of laboratory management from the perspective of a professional who is both a scientist and a manager. Topics areas would include: managing budgets, personnel, technology, information, funding, training, safety, risk, expansion, building or renovation, among others related to the role of a lab manager.

The article review process should begin with a query by e-mail or phone followed by a brief abstract or outline. Please state your topic and objective, and indicate your perspective as well as your professional relationship to the topic. Content must be unbiased and cannot promote a particular product or company. Article length may range from 1500-2500 words. All manuscripts must be submitted electronically by email or disk.

To submit an article query contact:

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Lab Manager Magazine

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Just like the great, big E on the top of an eye chart, the letter E for electronic has carved a "hard to ignore" spot in much of what we do everyday. From e-mail, to e-commerce, to e-zines and beyond, the electronic connection has become a critical link to staying in touch with current news, events, and trends. In fact, it's become a reliable source that we've all come to depend on in just a relatively short amount of time.

In a 2006 Pew Report titled, "The Internet as a Resource for News and Information about Science", it was found that, "Fully 87% of online users have at one time used the internet to carry out research on a scientific topic or concept and 40 million adults use the internet as their primary source of news and information about science."

In addition, the report goes on to say that "Happenstance also plays a role in users' experience with online science resources. Two-thirds of internet users say they have come upon news and information about science when they went online for another reason."

Not all scientific e-news has to be "happened upon."

It is obvious that many people prefer to receive their scientific news and information in electronic form. In keeping with this trend, *Lab Manager Magazine*® has added an E to our offerings. The *Lab Manager* e-newsletter was launched in January. This weekly electronic publication is distinct from the print magazine in more than just format. Unlike the *Lab Manager* digital version, which is an electronic replication of the print magazine, the e-newsletter is a publication of its own. The content cannot be found in the magazine. The feature articles, news, and links are timely and reflect the latest information, products, and more — along with management tips and topics.

E-newsletter editor, Bill Burke, has recently joined our staff and brings a newspaper reporting and website background. The e-newsletter content is gleaned from a wide variety of sources. In addition to sifting through the web for relevant material, your contributions and ideas are welcome. As with many things on the web, involvement and interaction can become part of the mix. It is this type of communication that makes the e-newsletter an exciting addition to the print magazine. You can email ideas and suggestions to bburke@labmgr.com

The *Lab Manager* e-newsletter is distributed weekly and like the print magazine, subscriptions are free and available at www.labmgr.com

Patrice Galvin

Nova Holdings LLC

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Nova Holdings LLC, the Parent Company of Nova Analytics Corporation and the newly formed Nova Technologies Corporation, has emerged as a worldwide leading supplier of electrochemical measurements, flow analysis products and services for the environmental and industrial markets.

NOVA ANALYTICS Nova Analytics Corporation was founded in March of 2003 in Woburn, Massachusetts. Funded by three Boston based venture capital firms, Nova's first acquisition was a small electrochemistry product line from Corning Life Sciences. Over the next six months, Nova acquired WTW GmbH, a premier wastewater measurement company, and Schott Instruments GmbH, a leading supplier of pH/ ISE electrodes, titration, and viscometry instrumentation.

In the first year, Nova Analytics grew into the largest privately-held, independent electrochemistry business in the industry. Nova spent 2004 turning around the first group of companies providing a firm business foundation with very strong financial performance to fuel its growth. In 2005, Nova continued its acquisition strategy and purchased Secomam, a French spectroscopy business and ADS, a US flow analysis business. Nova Analytics continued its focus on building brand presence, market access, and superior financial performance of all its businesses.

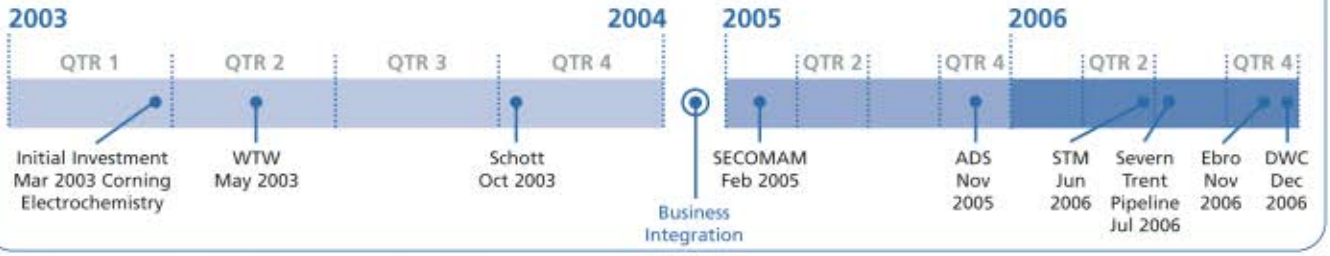
NOVA TECHNOLOGIES

As the portfolio of companies grew, so did the need to align the technologies, markets, and customers. In June 2006, Nova Holdings and Nova Technologies were created to support the growing portfolio of companies. Nova Analytics acquired Sensortechnik Meisnberg, a sensor manufacturer and moved ADS into Nova Technologies allowing an enhanced focus on flow analysis and services. In July, Nova Technologies quickly added Hydra-Stop and the Severn Trent Pipeline Services business to strengthen its market access and presence in the flow analysis markets. The Nova group was now positioned to continue with its innovated growth strategy which has been clear and straight forward since startup, "placing great value on brands and employees," according to Jim Barbookles, Nova's Chairman, CEO, and founder, "we have no geographical boundaries, no set playbook, we just acquire good companies that need a little extra care, direction, and focus. Nova's strong management team, many from within the industry, is key to our success; they focus portfolio companies on efficient business process improvements."

While Nova is just three years young, many of its brands have existed for 50-60 years. "The equity and knowledge behind these brands is where all of our value is derived," according to Barbookles. "Nova has been successful with all of its acquisitions by avoiding the common trends of over emphasizing consolidation and outsourcing. Introducing a fresh strategy, quality, consistency, and work force flexibility has provided greater economics than one would gain from forced business synergies," Barbookles stated.

As for Nova's scalability and future growth. "Look for it to continue, we have a wide array of opportunities and the management team truly enjoys the challenges that lay ahead," said Tom Paquette Executive Vice President. When asked what the best measurement of success at Nova is, Barbookles states, "When your initial investors continue to financially support your strategy!"

Nova's Acquisition Timeline



To find out more about the Nova companies, visit www.novavg.com.

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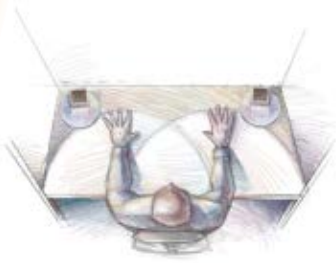

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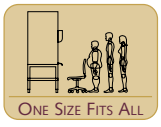

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Software Scientists

A GROWING NUMBER OF SCIENTISTS ARE WORKING FOR FIRMS DESIGNING SOFTWARE THAT MODELS CHEMICAL AND PHYSICAL PROCESSES.

Designing scientific software and helping people use it offer interesting opportunities for computer-savvy scientists. For example, "New developments in computing power, predictive technologies, and information management and analysis techniques hold the key to unlocking the productivity potential in the discovery of new drugs and materials," said Dr. Frank Brown, Chief Science Officer of Accelrys, Inc. Accelrys Lead Scientist Klaus Stark explains, "Simulation is very important to solve both academic studies and industrial problems as quickly as possible. It also helps avoid unnecessary and sometimes dangerous experiments." He cautions, "Simulation must agree with experimental results; it doesn't replace the need for experimentation. It is another tool to help scientists solve problems and answer questions."

A growing number of independent firms develop and market various types of scientific software. Many of these firms are described on the website www.chemindustry.com/category/620.html. According to Dr. Stephen Mumby, Senior Account Director, Materials Science at Accelrys, of the 500 Accelrys employees, "half are chemists of every flavor." Additional "software scientists" work for pharmaceutical and other firms that either license software from software design firms or have develop and use their own software.

Accelrys Lead Scientist Klaus Stark (Photo courtesy of Accelrys, Inc.)

Researchers increasingly use software to model molecular behavior and both chemical and physical processes. These include chemical synthesis and chemical process engineering, molecule design (for applications in drug design, catalysis, and other areas), drug action within the body, and resource recovery, particularly oil and gas production. Using computer software to simulate materials and processes enables scientists to better understand them, reduce development time for new products and processes, and operate commercial operations, such as oil production, more efficiently.

In addition to modeling molecules and processes, scientific software for a variety of other uses has become commercially available.

In addition to modeling molecules and processes, scientific software for a variety of other uses has become commercially available. Informatics is the management and analysis of data using advanced computing techniques. For example, chemists are inundated with huge amounts of data: spectral data, synthetic records, stereochemically complex chemical structures, structure-activity relationships, pharmacological studies, and enormous arrays of data from high-throughput screening and combinatorial chemistry. Cheminformatics software facilitates the collection, storage, and manipulation of these data to provide useful information. Bioinformatics software is important in genomics research because of the large amount of complex data this research generates.

Other types of software include science, engineering and medical databases, specialized data analysis programs, electronic notebooks, and chemical drawing software.

JOB MARKET

In many fields of science, "traditional" jobs that sustained employment and provided rewarding careers are becoming fewer. For example, according to the American Chemical Society's ChemCensus survey of all its working members conducted every five years, the percentage of

John K. Borchardt

Perry Francis, Director, Quality Assurance for Schrödinger at the National Chemical Exposition, San Francisco (Photo by John K. Borchardt)

members working for manufacturing companies has declined from 58.0% in 1985 to 51.9% in 2005. (These manufacturers include drug, chemical, and other types of manufacturing companies.) In contrast, the percentage of members working for non-manufacturing firms, such as software developers and service providers, has increased from 9.9% to 11.8%. For chemists aged less than 40 years, 14.2% were employed in this sector.

Career paths in the software industry are "almost unlimited," says Tripos Application Scientist, Dr. Tamsin Mansley. "People can move from one post to another as their skills are required. Research, customer support, sales, marketing, software development (computer programming), and product management (making decisions about features, enhancements, and bug fixing) are required for introducing new and updated software products."

BACKGROUNDS

So what are the backgrounds of scientists and engineers working in this exciting and growing field? Many used computer simulation in their graduate or postdoctoral research. For example, Dr. Brown received his Ph.D. in physical organic chemistry from the University of Pittsburgh and did postdoctoral studies in simulations on biological systems at the University of California, San Francisco. Dr. Stark used existing software to develop potential energy surfaces and perform predictive calculations on these surfaces at the University of Stuttgart. His post-doctoral research in physics focused on computer studies.

Nowadays, "even experimental chemists usually have some exposure to simulation software," Stark notes. He observes that, working in the software industry, it is not necessary to have programming experience if one goes into development work or focuses on working with customers to solve their problems or marketing.

After completing her Ph.D. in the U.K. and a two-year post-doc in the U.S., Tripos Application Scientist Dr. Tamsin Mansley began her career in the U.K. working in a medicinal chemistry research lab. After two years, she returned to the U.S. to work for UCB Research, Cambridge, Massachusetts. She had 10% of her time to work on her own interests. Mansley took advantage of this time to develop computer modeling skills. In 2002, she took an ACS short course, Computational Chemistry and Computer-aided Drug Design: Practical Approaches. She then used her new skills on her medicinal chemistry projects.

Dr. Jerald Baronofsky is Director of Marketing and Sales/Desktop Applications at CambridgeSoft. He completed two post-docs after earning his degree in biochemistry in 1981 and worked for three biochemical companies before joining software company SciVision. Hired without experience in simulation software, he notes, "It took a lot of work but I picked up what I needed to know on the fly." He went to work for CambridgeSoft in 1997.

Lei Wang did computer work for her biophysical chemistry Ph.D. to support NMR structure determinations. She had used Tripos software over five years and liked it. A recruiter sent a Tripos job description to the department chair. Wang says she "liked the aspect of helping people" and thought the job would be very rewarding.

Some scientists work in marketing and sales. Wang observes, "Sales is a nice career option for B.S. and M.S. chemists."

FINDING THE JOB

Other software scientists report that they came to their jobs by a variety of routes. Stark saw an advertisement in a computing newsletter about a job opening at Accelrys. He contacted a friend working at Accelrys to learn more about the job and company. Based on what he learned, he applied for a job there. He reports that another reason for applying was, "At the time, it was hard to find jobs in the traditional chemistry job market." In addition, "Working on a variety of diverse problems was very appealing." Stark began working for Accelrys in 1997 at Cambridge in the U.K. Later he transferred to Munich, Germany and then to Houston, Texas.

In 2004, Mansley was considering moving out of the lab and working for a software company. She learned about software careers and about Tripos in particular from a UCB Research scientist who formerly worked for Tripos. At the end of the summer, UCB announced they were closing UCB Research in early 2005. Dr. Mansley had to decide whether to look for another laboratory research job or work

on computer simulation full-time. Meanwhile, Dr. Paul Hawkins, an applications scientist at Tripos who had met Mansley at an ACS short course, called her about a Tripos job opening that called for a medicinal chemist. As a result of this networking, Mansley began working for Tripos in the spring of 2005.

Wang notes that, during their employment interviews for software applications positions, job hunters should demonstrate that they understand basic concepts of computer modeling. Baronofsky suggests that job applicants should be familiar with the employer's current products — what they can do — and it is even more helpful if they have experience in using the software. He says that CambridgeSoft is particularly interested in applicants that have ideas for useful new software applications.

Prior job experience, even if it is not in software, can aid in landing a job with a software firm. For example, Perry Francis, Director, Quality Assurance for Schrödinger, first worked for Safety-Kleen after getting his B.S. in chemistry. He explains, "This included working to ensure quality assurance/quality control was met in Safety-Kleen's hazardous waste analysis laboratory." After earning an M.S. degree in chemistry, he began working for Schrödinger. "My QA experience was an important factor in my getting hired," he says. "This experience has been very useful to me at Schrödinger." In addition to "being sure that software works properly in customers' hands," he determines what additional features customers would like in software updates.

ON THE JOB

The largest single group of scientists working at computer modeling firms work as applications scientists. They generally attend two to three tradeshows annually, usually including both American Chemical Society national meetings. Many travel extensively. For example, Wang and Mansley travel about 30% of their workdays. Stark frequently travels to Europe and Asia. All three work out of home offices when they aren't traveling. Baronofsky travels 10–15% of his work time.

Many scientists enjoy the variety offered by software jobs. Stark says his foremost job responsibility is "working with customers, both industrial and academic scientists, to develop strategies to solve their problems." What Stark likes most is "the diversity of different problems customers have." This means he has to learn how to tackle many different kinds of problems and keep up-to-date technically. He began working on catalysis problems but has also worked on problems for semiconductor, pharmaceutical, and other companies. His job offers opportunities to write and publish research papers. These often issue under joint authorship with Accelrys' customers. For example, Stark notes, "I published a paper on Fischer Tropsch catalyst cycles with collaborators from Sasol."

Tripos staff members (from left to right): Tamsin Masley, Application Scientist; Gunther Stahl, Senior Application Scientist; Lei Wang, Application Scientist; Shelley Whittaker, Academic Sales (Photo courtesy of Tripos, Inc.)

Mansley also enjoys the wide variety of her job responsibilities. "No two days are the same," she observes. A major chunk of her time is spent in customer support — both pre- and post software sales. She helps customers determine what software modules they need to solve their problems. The wide range of her duties means "time management can be a real challenge."

Wang likes "working with customers helping them use Tripos software. I enjoy the people interactions." Her major challenge is "digging deeper to solve customers' problems and issues."

As part of his marketing responsibilities, Baronofsky works with North and South American software resellers and distributors of CambridgeSoft products. He also manages CambridgeSoft sales of other companies' products like Hyperchem. He serves as a liaison to book publishers who bundle CambridgeSoft programs with college textbooks. He is also responsible for training customer personnel on certain software products. Baronofsky's challenges include "taking our products and figuring out what else customers can use them for and developing good, useful training materials."

Challenging work assignments, working with interesting people, and helping other scientists solve challenging problems — software careers offer interesting career options for scientists and engineers in a variety of fields.

Dr. Borchardt *is a consultant and technical writer. The author of the book "Career Management for Scientists and Engineers," he writes often on career-related subjects. He can be reached at jkborchardt@hotmail.com.*

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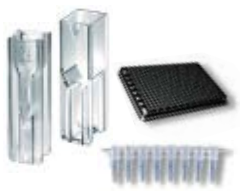

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When gas chromatography (GC) is used to separate a complex mixture, selection of the appropriate carrier gas and the optimum source for the carrier gas in GC are critical decisions for the laboratory manager. The manager should select the carrier gas that provides the desired separation in the minimum period of time to optimize the throughput of the laboratory. In addition, once the appropriate gas has been selected, the manager must then evaluate the various potential sources of that gas to determine how it should be supplied to ensure laboratory safety, convenience, and minimize the cost of the gas.

Historically, nitrogen or helium has been employed as the carrier gas in GC. When hydrogen is used, it is typically provided to the chromatograph via a high-pressure tank with appropriate pressure reduction valves and tubing. While this approach is fairly straightforward, it suffers from a number of disadvantages, including the dangers inherent in working with pressurized gas, the cost of the tanks, and the inconvenience of having to replace tanks on a periodic basis.

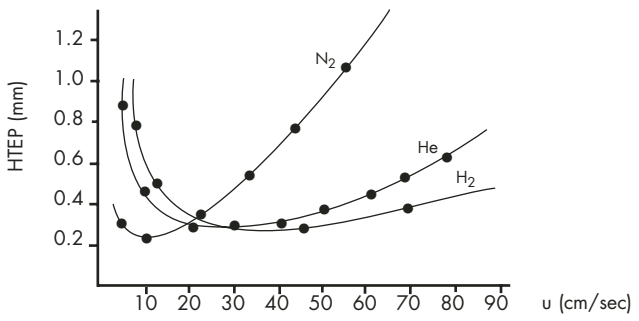

Figure 1. Van Deemter Plot for N_2, He, and H_2. While N_2 provides the highest chromatographic efficiency, the optimum velocity for H_2 is considerably greater, so the use of H_2 as the carrier gas leads to analysis times that are four times faster than when N_2 is used.

The major benefit of hydrogen is the fact that it can lead to a dramatic reduction of the time required for a given separation.

HYDROGEN — AN APPROPRIATE CARRIER GAS FOR GC

Hydrogen is an extremely useful carrier gas for GC and provides a number of significant benefits compared to the use of helium or nitrogen. The major benefit of hydrogen is the fact that it can lead to a dramatic reduction of the time required for a given separation. In addition, hydrogen frequently allows for the use of a lower temperature for separation, thereby increasing column longevity. Besides its use as a carrier gas, hydrogen is used in GC as a fuel gas for flame-ionization detectors (FIDs) and as a reaction gas for Hall detectors.

Three gases are commonly used as carrier gases in GC: nitrogen, hydrogen, and helium. While nitrogen provides somewhat higher chromatographic efficiency than hydrogen, the overall consideration is to obtain the required separation in the minimum period of time. The van Deemter plot (Figure 1) shows that the use of nitrogen provides a shorter theoretical plate (0.22 mm) than hydrogen (0.28 mm), which leads to a greater number of plates for a column and provides better resolution than either hydrogen or helium. It should be noted that the maximum efficiency for nitrogen is obtained at a linear velocity of 8–10 cm/sec while the optimum

Peter Froehlich

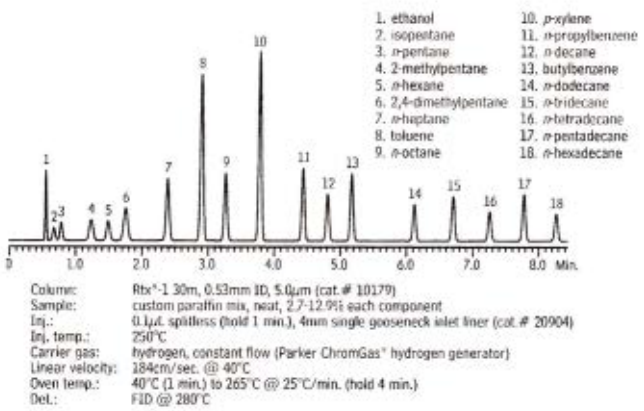

Figure 2.Separation of Simulated Distillation Reference Mix (Courtesy of Restek, Inc.)

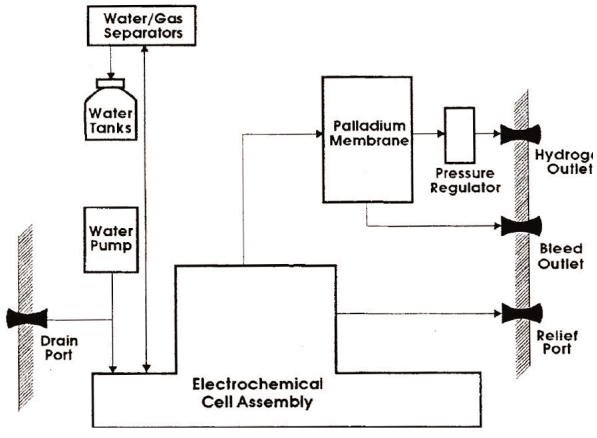

Figure 3. Schematic Diagram of Hydrogen Generator

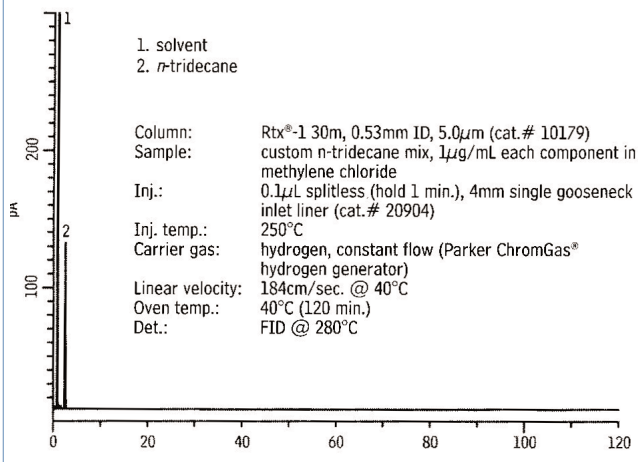

Figure 4. Chromatogram Demonstrating Parker Balston Hydrogen Generator Stability. The output from an FID monitor was recorded for two hours (Courtesy of Restek, Inc.)

linear velocity for hydrogen is approximately 40 cm/sec, which leads to a four-fold decrease in the average analysis time. While the efficiency of nitrogen is somewhat better than hydrogen, the decrease in analysis time is significant and suggests that the throughput of the laboratory can be dramatically improved by using hydrogen as the carrier gas.

A chromatogram showing the separation of a standard reference mix using hydrogen as the carrier gas is presented in Figure 2. This separation was performed in less than nine minutes using an Rtx® -1 column (0.53 mm id, 5 µm); the same separation took more than four times as long with nitrogen. A very satisfactory separation was obtained and the retention times are extremely repeatable.

Since the use of hydrogen provides a significant reduction in the time for separation, the analyst could reduce the column temperature for separation. Although this will lead to a slightly longer separation time, the lifetime of the column will be greater, leading to further economic benefit.

While both hydrogen and helium are more satisfactory gases than nitrogen, there are several drawbacks to the use of helium. It is quite expensive, is a non-renewable resource, and has limited availability in many parts of the world. In contrast, hydrogen is readily available via the electrolysis of water or as a high-pressure bottled gas.

GENERATION OF HYDROGEN VIA THE ELECTROLYSIS OF WATER

The generation of hydrogen in the laboratory via the electrolytic dissociation of water provides a convenient, safe, reliable andeconomical method to provide the gas for GC. This two-step process is described in equations 1 and 2.

1. $H_2O \longrightarrow 2H^+ + O^{2-}$
2. $2H^+ + 2e^- \longrightarrow H_2$

The protons that are formed via the dissociation of water are allowed to cross a membrane and form molecular hydrogen.

A schematic diagram of a typical hydrogen generator is presented in Figure 3. The hydrogen generator includes an electrochemical cell that contains a solid polymer membrane to support electrolysis. The system operates at a potential of approximately 7 V (depending on the desired flow rate).

A specially designed palladium membrane is included in the design to optimize the purity of hydrogen (99.99999+ %). The palladium membrane is heated to greater than 600 °C so that only hydrogen and its isotopes can pass through the pores; this provides gas with an oxygen content less than 0.01 ppm and a moisture content less than 1.0 ppm, at flow rates up to 800 mL/min at a pressure of 100 psi.

This type of hydrogen generator produces a steady, dependable, and precise flow of gas. As an example, the

chromatogram shown in Figure 4 demonstrates FID baseline stability over a two-hour period. In addition, a series of ten runs was performed for the simulated distillation mix described in Figure 2, with extremely reproducible retention times (Table 1).

Component	Mean	SD	96 RSD
1. ethanol	0.547	1E-03	0.1765
2. isopentane	0.67	1E-03	0.1484
3. n-pentane	0.779	0.001	0.169
4. 2-methylpentane	1.232	0.001	0.1198
5. n-hexane	1.488	0.001	0.0992
6. 2,4-dimethylpentane	1.753	0.001	0.0721
7. n-heptane	2.387	0.001	0.0442
8. toluene	2.904	0.001	0.0356
9. n-octane	3.266	7E-04	0.0214
10. p-xylene	3.784	7E-04	0.0195
11. n-propylbenzene	4.438	5E-04	0.0109
12. n-decane	4.809	4E-04	0.0088
13. butylbenzene	5.174	5E-04	0.0102
14. n-dodecane	6.116	5E-04	0.0079
15. n-tridecane	6.703	5E-04	0.0077
16. n-tetradecane	7.255	7E-04	0.0097
17. n-pentadecane	7.774	6E-04	0.0081
18. n-hexadecane	8.264	6E-04	0.0069

Table 1. Retention Time Reproducibility for Simulated Distillation Mix Components (Summation of 10 Runs)

BENEFITS OF A HYDROGEN GENERATOR

A hydrogen generator provides a continuous stream of gas at a flow rate that is required to maintain a number of gas chromatographs and provides three major benefits:

- Minimizes the safety hazards of hydrogen tanks
- Eliminates the inconveniences of hydrogen tanks
- Is considerably less expensive than hydrogen tanks

MINIMIZING SAFETY HAZARDS

When a hydrogen generator is employed, only a small amount of gas at low pressure is produced in a given period of time and the gas is ported directly to the chromatograph. Typically, the generator has a storage compartment that holds only 50 mL of stored gas at a maximum pressure of 4 atm. In contrast, if the contents of a full tank of hydrogen were suddenly vented into the laboratory, up to 9000 L of the gas would be released, creating the possibility of an explosion and/or reducing the breathable oxygen content of the atmosphere, thereby creating an asphyxiation hazard to the laboratory occupants.

When a new gas tank is required, the analyst must transport a tank from a secure storage area to the laboratory. A standard tank is quite heavy and can become a guided missile if the valve is compromised during transportation. With the hydrogen generator, there are no transportation issues and the output from the generator is permanently plumbed into the chromatograph. If a leak were to occur, there is little danger of explosion or asphyxiation as the quantity of gas is small.

CONVENIENCE ISSUES

When a hydrogen generator is employed, the gas is supplied on a continuous basis and can be provided on a 24 /7 basis if desired. In contrast, when tank gas is employed, tanks must be replaced on a periodic basis. If the need for replacement occurs during a series of analyses, the analyst must interrupt the analytical work to restart the system, wait for a stable baseline, and may have to recalibrate the system.

The hydrogen generator is a self contained unit that requires the user to simply add water on a periodic basis. The tank can be refilled during operation, so there is no down time. When a hydrogen tank is employed, it is necessary to replace the tank. In contrast, "multiple gas chromatographs can be operated with essentially no interaction with a hydrogen generator," according to Dr. Lionel Nesbitt of Mastertaste Foods, a manufacturer of natural fruit flavors in Clark, NJ.

In many facilities, spare gas tanks are stored outside in a remote area (for safety reasons) and it may be time consuming to get a replacement cylinder. When it is necessary to get a tank, the chromatographer may need to get an individual who is qualified to handle the tanks. Many users, including Reza Bibiano of Genzyme, have indicated that replacing used tanks can be a significant inconvenience, especially in inclement weather if the tanks are stored outside.

COST ISSUES

In addition to the significant safety and convenience benefits, a hydrogen generator can provide a significant economic benefit compared to the use of gas tanks. The running cost of operation of a hydrogen generator is exceedingly low as the raw materials to prepare hydrogen are deionized water and electricity. On a periodic basis, the deionizer bag (which is used to filter the water that is recycled during the operation of the instrument) should be replaced; in most instances, the bag is replaced twice a year at an expenditure of approximately $100. It has been estimated that the running costs and maintenance for the hydrogen generator is approximately $225/year.

A recent cost estimate for a laboratory that uses two—three cylinders of hydrogen per week is in the range of $15,000–25,000/year. While the calculation of the precise cost of each approach for a given user is dependent on a

broad range of local parameters and the amount of helium or hydrogen that is used, it is quite clear that the use of the hydrogen generator leads to a considerably lower cost than the use of tank gas.

When tank gas is employed, there are many hidden costs, including transportation costs, demurrage costs, and paperwork (e.g., a purchase order, inventory control, and invoice payment). In addition, the value of the time required to get the tank from the storage area, install the tank, replace the used tank in storage, and wait for the system to re-equilibrate after the tank has been replaced has an economic cost.

The cost benefit of a hydrogen generator increases dramatically as the number of gas chromatographs in the laboratory increases. As an example, the laboratory of Reza Bibliano of Genzyme operates six GC systems with hydrogen carrier gas using a single hydrogen generator. In the past, it was necessary to replace the hydrogen tank approximately every three weeks — now the single generator meets all the needs. The gas generator has been in operation for three years with no difficulties.

In a typical example, Henkel Loctite (Rocky Hill, CT), a manufacturer of high-technology sealants, adhesives, and coatings, required one tank of helium per week to supply carrier gas for each of two GC/FID systems in the analytical services laboratory. The out-of-pocket cost of the gas was over $8,500/year. When the lab moved to a new facility, it replaced the tank helium with hydrogen and obtained better quality separations for high-sensitivity methods. This approach saved nearly $20,000/year.

CONCLUSIONS

The use of hydrogen as a carrier gas for GC provides more rapid separations than nitrogen, with a minimum loss in chromatographic efficiency. The mode of supplying hydrogen is via the electrolysis of water. A hydrogen generator creates a steady stream of gas at a low pressure and stores a very small quantity of the actual gas, so that safety issues due to the potential of an explosion are dramatically minimized. In addition, the hydrogen generator is more convenient than tank gas, requires essentially no maintenance, and reduces the cost of hydrogen relative to the use of tank gas. A single hydrogen generator can provide the carrier gas for several GC systems as well as the gas needed for detectors.

Dr. Peter Froehlich *has over 30 years of experience in the analytical instrumentation industry. He was awarded a Ph.D. from Purdue University and has a background in chromatography and spectroscopy. He is the President of Peak Media, 10 Danforth Way, Franklin, MA, 02038 and can be reached at 508 528-6145; pfpeakmedia@msn.com.*

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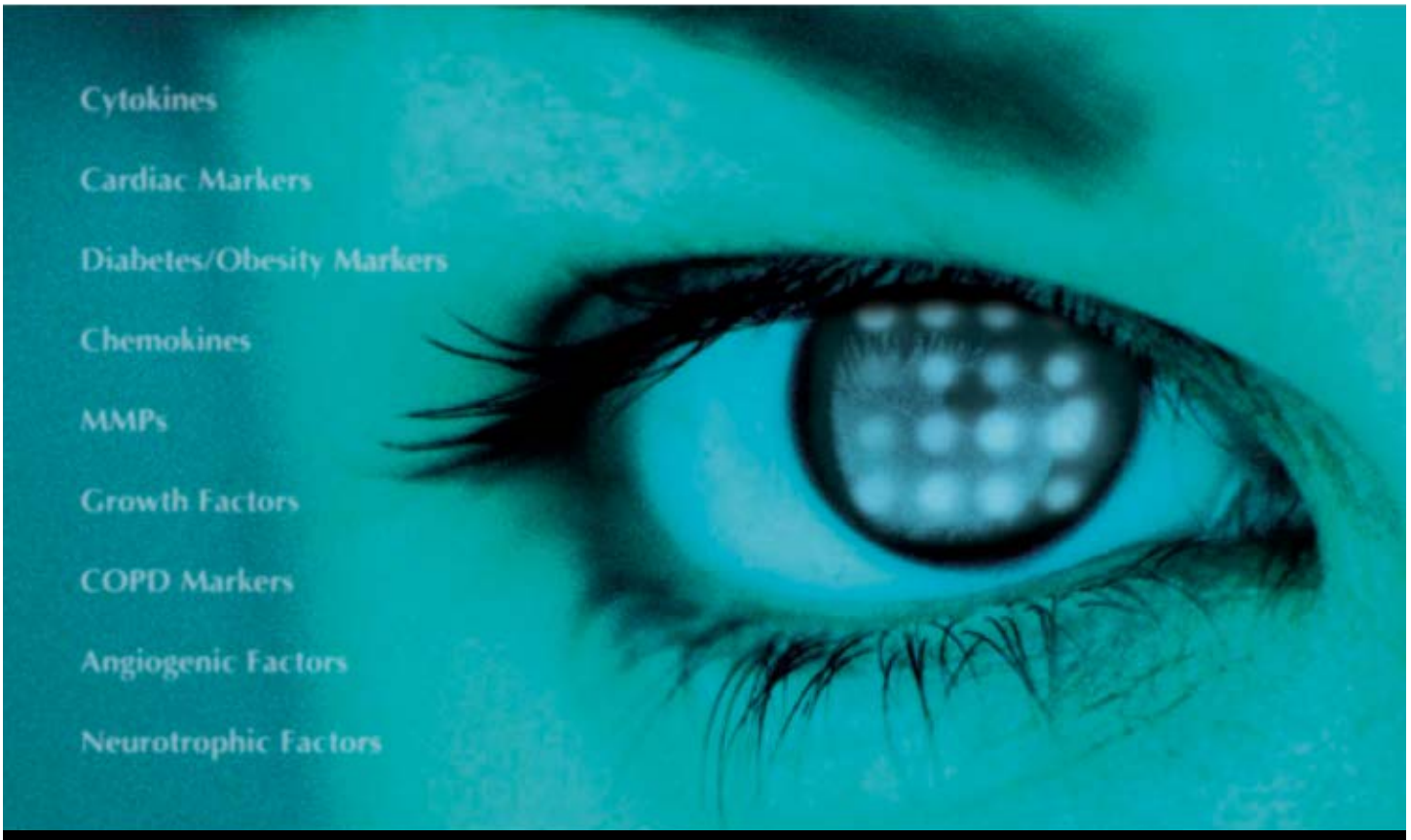

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Feedback Tools in Laboratory Quality Systems

ONE OF THE NEW REQUIREMENTS IN ISO/IEC 17025:2005 IS TO ACTIVELY SEEK THE FEEDBACK OF LABORATORY CUSTOMERS AND DO SOMETHING WITH IT TO IMPROVE THE MANAGEMENT SYSTEM AND THE TECHNICAL ACTIVITIES. FAIRLY AMBITIOUS WORDS.

What does a customer feedback system mean to a lab? Or to any organization that is contemplating the use of an active feedback system? Simply put, it means that the organization has to implement some method of collecting data on how their customers feel about the services they use, the treatment they receive, the interactions they experience, and the expectations they take into their relationship with the organization.

FEEDBACK IS ABOUT PERCEPTION

How do the laboratory customers feel about the service and the methods used by the laboratory to interact with their customers? How do they feel about the way the laboratory treats them, or whether their expectations are being met? From the way these questions are worded, it is clear that feedback is generally used to measure perception — customer perception of the laboratory, the organization, the laboratory staff, and the work of the laboratory.

EXAMPLES FROM AN ACCREDITATION BODY

If ISO/IEC 17025 calls for this sort of activity explicitly, and CAEAL conducts assessments of laboratories against this standard, it might be useful for laboratories to appreciate how CAEAL has been acquiring and using feedback. Besides, how can an accreditation body ask labs to have feedback systems and not use one themselves?

Assessors and assessed labs are very familiar with the feedback provided at the end of an accreditation assessment activity. For this accreditation body, all laboratory responses to the site visit evaluation are collated each year into one document and submitted to the Board of Directors as part of the measurement metrics of the accreditation program. The 2005 collation resulted in a 16-page table.

Feedback is generally used to measure perception — customer perception of the laboratory, the organization, the laboratory staff, and the work of the laboratory.

Proficiency testing (PT) providers, CAEAL included, routinely ask members to comment on specific aspects of the PT program. Occasionally, as was done in 2004, this may include the holding of PT workshops to openly discuss issues of interest to the laboratories. More recently, CAEAL surveys of member needs have resulted in the implementation of a new PT scoring system while other results continue to tweak the implemented approaches.

The CAEAL Training Service also encourages members to make use of the web page (http://www.caeal.ca/t_summaries.html) containing published feedback from other members who have previously taken training — the good and the bad.

MAKING USE OF THE INFORMATION RECEIVED

CAEAL's very visible methods of feedback are used to modify goals, objectives, approaches, and delivery methods within CAEAL programs and that is what ISO/IEC 17025 is looking for laboratories to do with their own feedback mechanisms. Feedback systems can deliver valuable information to laboratories in real time.

In good laboratories, feedback can have constant, appreciable, positive, and relevant impact on what is done and how it is done. This approach is in line with best practices in

J.E.J. (Ned) Gravel

continual improvement and is the main reason why the 2005 version of ISO/IEC 17025 now includes a requirement for active acquisition of customer feedback.

What are the potential immediate effects of all this feedback on the organization collecting and using it? For a laboratory, it means increased use of current data to affect the direction and methodologies of the laboratory — and less use of "that is how we have always done it."

Good and useful feedback mechanisms do not affect the underlying scientific method in any test or calibration, but they may affect the supporting procedures and the customer interaction processes.

PUBLISHING FEEDBACK IS ONLY A SECONDARY BENEFIT

Feedback can also be used to import external support for the marketing of a laboratory and its services. However, organizations that collect, use, and publish feedback may be disappointed because most of their customers will never read or be influenced by this published feedback.

Such is also CAEAL's experience. It may be surprising that customers rely so little on what other customers may have to say about the organization or the laboratory. For example, only one in 50 CAEAL Training Service participants admit to visiting the CAEAL training feedback site to review what others have said about us before they purchase training. So the real advantage of feedback is not the more obvious "pat-on-the-back" from customers. It is the contribution made to improving services and delivery.

ENHANCING PERCEPTION

Both CAEAL and member laboratories would express the same sentiment about providing service to customers if asked: "It must be high quality and it must meet stated needs." Many feel it important to collect member feedback and make use of it. As a result of a change in the accreditation standard, we may all become a little more conscious of the usefulness and application of feedback in our own organizations, and perhaps seek the published feedback of those we buy services from.

***J.E.J. (Ned) Gravel, P.Eng.**, CALS, CAE, is the Manager, Quality and Training for the Canadian Association for Environmental Analytical Laboratories (CAEAL). The association is a public-private partnership that provides services to over 380 member laboratories including PT services, accreditation, and training; www.caeal.ca*

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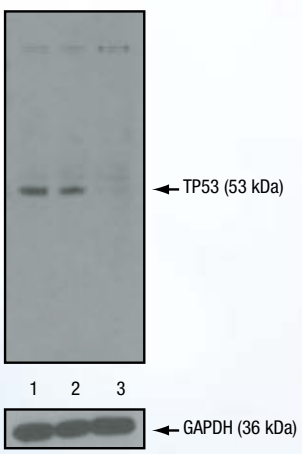

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To Outsource or Not to Outsource: That is the Question

ALL LABORATORIES HAVE DIFFERENT RESEARCH NEEDS, TECHNOLOGY REQUIREMENTS, AND WORKFLOW PATTERNS. BECAUSE OF THESE UNIQUE FEATURES, EACH LAB MANAGER IS TASKED WITH WHAT CAN BE A DIFFICULT DECISION — WHETHER TO BOLSTER THE LAB WITH THE ASSISTANCE OF WELL-CHOSEN OUTSOURCING VENDORS OR BUY THE TECHNOLOGY NECESSARY TO COMPLETE ALL TASKS IN-HOUSE. WHICH IS THE BETTER OPTION?

This article discusses these options in relation to recent trends in the area of drug discovery, including outsourcing, the availability of new technologies, and maximization of workflow within the lab.

As the field of high-throughput screening matures and the number of validated targets increases, there is a greater desire among all pharmaceutical companies to "screen smarter" within existing resource constraints. The development of more physiologically and biochemically relevant assays, the testing of smaller and more focused compound libraries, and the increase in compound selectivity and specificity profiling at an earlier stage have all been implemented within screening groups to meet these corporate goals.

Because of its complexity, compound profiling has proven to be the one area where outsourced compound testing has effectively competed with the in-house development of a profiling panel for a particular target class.

This burden on resources, for both reagents and technical staff, combined with the workflow changes and data analysis requirements is significant, making outsourcing a compelling alternative.

The development of an in-house profiling panel provides many benefits to a screening group and their internal therapeutic group customers. Assay target expertise, rapid compound turnaround, and the ability to work closely with medicinal chemistry groups to rapidly profile compounds shortens the discovery process, making in-house profiling very desirable. However, there are significant staff, reagent, workflow, and data analysis process costs associated with the set-up and maintenance of such a panel.

Each of the assays within the panel has to be developed and validated — this can take as much as two to three weeks depending on the tractability of the target and the assay methodology selected. Reagents for each assay have to be sourced, tested, validated, and ongoing supplies ensured. The workflow process has to be defined. Typically, screening laboratories are set up to process a large number of samples at a single concentration against a single target with the follow up of hits against the same target. The profiling workflow requires the testing of a small number of test compounds at intermittent time periods against multiple targets. To manage this process and resource requirements, many labs schedule profiling assays at defined intervals. Although this manages the workflow, some of the flexibility benefits of in-house profiling are lost. The in-house screening data analysis systems are also designed primarily to process large data sets from a single assay; again, these systems have to be upgraded to meet the profiling process that requires small data sets to be compared against mul-

Kevin Keras and Simon Fogarty

tiple targets to determine compound selectivity. This burden on resources, for both reagents and technical staff, combined with the workflow changes and data analysis requirements is significant, making outsourcing a compelling alternative.

Outsourced profiling, while expensive and lacking some of the stated advantages of in-house profiling, can alleviate much of the resource burden associated with in-house programs. There are no assay development or validation costs, or ongoing assay maintenance and running costs. Compounds for testing are supplied direct to the outsourcing company and tested through the selected panel of assays. Prior to establishing an outsource profiling relationship however, the prospective customer needs to determine that the profiling services vendor meets the needs of the lab. This includes:

- Assay methodology — a full review of methodologies including detailed methods, SOPS, and kinetic and standard inhibitor data for each target should be obtained.
- Determine how compounds will be processed, including delivery requirements, storage, dissolution, test concentrations, replicate numbers, and concentration ranges if potency is to be determined.
- Agree on the format of data received from the vendor, determine how the data will be reported, and on the assay QC and pass/fail criteria.

Although this review process requires a significant investment of time by the potential customer, it is crucial to the long-term success of any partnership.

In response to the challenges associated with both outsourced and in-house profiling, a new generation of products is being developed that are cost-effective, easy to implement in-house, and faster than outsourcing.

Recently, ready-to-use kits have been introduced that pro-

vide users with the means to perform routine profiling against selected targets in a "pre-validated" homogeneous format. The need to accumulate sufficient compounds to batch outsource and the delays associated with the speed of turnaround are removed. The in-house issues associated with developing and maintaining multiple assays have also been removed with such pre-validated kits.

These types of kits typically consist of 384-well plates containing up to 24 targets. Assay set-up is simplified such that the user need only add compound and other assay reagents to the plate, incubate, and read the plate.

It is anticipated that in the near future, the role of "ready-to-use" profiling kits will expand within screening groups, providing the best of both worlds. Improved turnaround along with the elimination of costs associated with the development and long-term maintenance of an assay panel should enable therapeutic research labs to perform more frequent profiles at lower costs and with immediate access to data.

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lab agenda

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MARCH 24–27, 2007
CLMA Thinklab '07
Clinical Laboratory Management Association, Inc.
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MARCH 25–29, 2007
SOT 46th Annual Meeting & ToxExpo™
Society of Toxicology
Charlotte, NC
www.toxicology.org

MARCH 25–29, 2007
ACS National Meeting & Exposition
American Chemical Society
Chicago, IL
www.chemistry.org

APRIL 14–18, 2007
AACR Annual Meeting 2007
American Association for Cancer Research
Los Angeles, CA
www.aacr.org

APRIL 15–19, 2007
13th Annual SBS Conference and Exhibition
The Society for Biomolecular Sciences
Montreal, Canada
www.sbsonline.org

APRIL 28 — MAY 2, 2007
Experimental Biology 2007
Federation of American Societies for Experimental Biology (FASEB)
Washington, DC
www.faseb.org

MAY 17–18, 2007
IMACS 2007
International Meeting on Automated Compliance Systems
Princeton, NJ
www.imacs-world.com

MAY 21–25, 2007
ASM 107th General Meeting
American Society for Microbiology
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JUNE 3–7, 2007
55th ASMS Conference on Mass Spectrometry
American Society for Mass Spectrometry
Indianapolis, IN
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JUNE 17–21, 2007
High Performance Liquid Chromotography (HPLC) 2007
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JUNE 24–27, 2007
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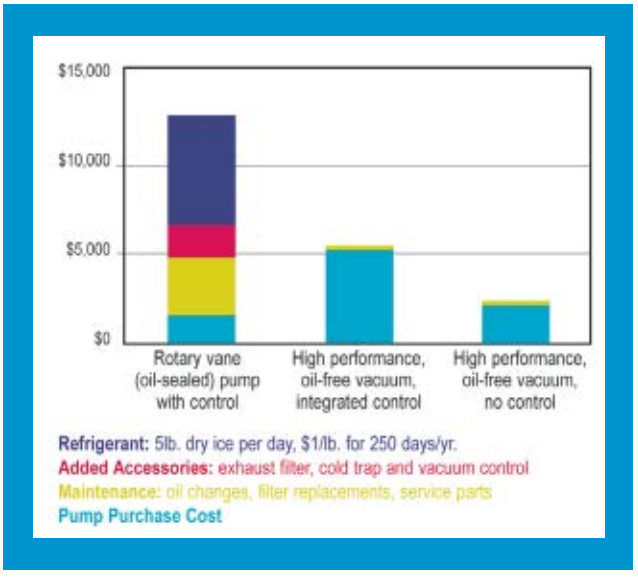

Figure 1. 5-Year Cost Comparision—Vacuum Pumps

WAIT! DON'T GO AWAY!

Most lab managers would agree that the "excitement quotient" of a vacuum pump is about the same as a water heater for your home. If all goes well, it sits there doing its job for years on end. You don't want to think about it until it fails, and then you want to replace it as quickly and inexpensively as possible, and get on to more productive uses of your time. Taking a little time to get the right vacuum pump, however, can make all of the contributions to lab productivity mentioned earlier. Here's how.

VACUUM "MAKES IT HAPPEN"

Vacuum is what "makes it happen" in all sorts of ways in the laboratory, by powering filtration, degassing, evaporation, separation, and concentration operations. When you don't have the right vacuum levels, filtration or degassing is either too slow or your filtrate/mobile phase boils. When you're evaporating, poor vacuum control results in slow evaporation or violent boiling, causing sample loss or cross-contamination. Separation of solvent mixtures is much less effective when vacuum levels don't match vapor pressures. Furthermore, vacuum allows you to minimize the amount of heat you use when evaporating reagents, allowing you to concentrate heat-sensitive compounds without damage.

CLEANER, QUIETER WORK ENVIRONMENT

Many labs still rely on ancient oil-sealed rotary vane vacuum pumps for lab vacuum. Some of these pumps — like that belt-driven monster that's so common — represent 70-year old technology. 70 years! They operate at a vacuum that is three orders of magnitude more than needed for common lab applications like evaporators, concentrators, or gel dryers. To get these pumps to operate at proper vacuum levels, they must be "dumbed-down" by introducing air that weakens the vacuum, but creates noise and oil mist as it blows through the pump. In contrast, oil-free vacuum pumps are specified to vacuum levels needed by typical lab applications. There's no oil to change or toxic waste oil to dispose of, and no oil to blow out into a smelly, chemical-contaminated mist that pollutes lab air and deposits a slippery sheen on benchtops and floors. These diaphragm pumps eliminate the roar of air by delivering the needed vacuum by design. The result is a cleaner, quieter work environment powered by a pump that usually takes up a lot less space as well.

HAPPIER, PRODUCTIVE SCIENTISTS

What scientist, after years of schooling in his or her discipline, wants to spend time serving as a mechanical controller for an archaic piece of equipment? Isn't that what electronics are for? Don't we set temperature with a thermostat and rely on the electronics to maintain the desired conditions? Why do many labs still rely on the oversight of vac-

Peter G. Coffey

uum processes by highly skilled scientists instead of relying on controls? Isn't there a better use for that scientist's intelligence and training than turning a pump on and off to approximate conditions that could be better maintained automatically?

The scientific mind is, by far, the most valuable and costly resource in a laboratory. Does it make sense to use a resource that costs, say, $60,000 a year, rather than purchasing vacuum pump controls that may cost a few thousand dollars and serve reliably for ten or twenty years or more? In a word, "No," yet lab managers make this decision routinely because vacuum pumps seem like such a mundane utility that their possible contribution to the work environment is often overlooked.

SHORTER PROCESS TIMES WHILE PROTECTING SAMPLES

Oil-free pumps with electronic controls can significantly shorten process times by keeping application conditions close to optimum. Traditional two-point technology (operating like a thermostat, with a set point and plus or minus tolerances) relies on a programmed setpoint or ramp that defines the desired conditions based on prior testing. Repeat runs are managed by the electronics, while the scientist attends to other pressing matters. In the most advanced control systems available, the vacuum system detects the changing vapor conditions of the application, and adjusts its own operation continuously to momentary optimum vacuum levels without test runs and ramp programming. Such controllers can achieve 30% shorter application times than even a programmed, two-point controller, while limiting bumping and boil-overs. Electronically controlled systems are clearly more expensive than uncontrolled vacuum, but they significantly accelerate processes even as they free staff for more productive work than manual pump oversight.

REDUCED SERVICE EXPENSE

Oil-sealed pumps require regular oil changes — sometimes weekly or monthly — because process vapors are in direct contact with pump oil. Contamination of the oil reduces its lubricating and sealing properties, and can add corrosive properties, so failure to change oil — a nasty job — can lead to pump failure, just as in a car engine. To protect the oil, oil-sealed-pump manufacturers recommend cold-traps to capture most process vapors before they reach the pump. Cold traps require dry ice or liquid nitrogen, or expensive, bulky, energy-intensive chillers. Besides the inconvenience of feeding dry ice traps, daily dry ice costs can equal the cost of a rotary vane pump in the first year, and keep on bleeding budgets for years to come.

A well-designed, oil-free laboratory vacuum pump can have a typical service interval of as much as 10,000 to 15,000 hours, depending on pump design and manufacturer. For a pump operated 20 hours a week for 50 weeks a year, that works out to be ten to fifteen years without oil changes, rebuilds, service interruption, or other maintenance. Besides eliminating the need for oil-changes, some designs feature fluoropolymer flowpaths that eliminate the need for cold-traps in most applications. With such pumps, dry ice or liquid nitrogen savings alone will normally recoup in the first year of service any premium paid for an oil-free, fluoropolymer-flowpath pump compared with an oil-sealed rotary vane pump. The convenience and service savings just go on and on for years.

BUT IS IT EXPENSIVE?

For all these reasons, it should be obvious that you should never use an oil-pump when an oil-free pump can do the job. (Certain applications, like freeze-dryers, need the deeper vacuum levels that only a rotary vane pump can deliver.) A good, oil-free diaphragm vacuum pump costs a little more than a rotary vane pump, and a full vacuum system with a chemical-resistant flowpath, electronic control, and built-in solvent capture may cost a few thousand dollars. So for about the cost of a decent scientific microscope, you can equip your lab with vacuum technology that is clean, quiet, cost-effective, and productivity-enhancing.

Modern vacuum control frees your scientists for productive use of their training and intelligence, enriching their jobs and eliminating tedious oversight of applications. Oil-free vacuum can save enough in service costs and vapor-capture consumables in a year or two to pay for the pump, bringing all of these advantages — for free — to the lab manager who can overcome the temptation to doze off at the mere mention of the mundane little vacuum pump.

Peter Coffey *is the Vice President – Marketing of BrandTech Scientific, Inc.;11 Bokum Road, Essex, CT 06426. He can be reached at 860-767-2562; www.brandtech.com*

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"Are You Still Synthesizing Oligos? Can you do (fill in your special need here)?"

IT'S 10:30 THURSDAY NIGHT. IT'S BEEN A BUSY WEEK AND I REALLY DON'T FEEL LIKE GOING BACK UP TO THE LAB TONIGHT. NONETHELESS, I PUT ON MY RAINCOAT AND HEAD FOR THE CAR. IT COMES WITH THE TURF — IF YOU WANT TO OFFER DNA SYNTHESIS AT AN ACADEMIC INSTITUTION, YOU'VE GOT TO FIND A COMPETITIVE NICHE.

Commercial "oligo houses" offer oligos so much cheaper but they can't get them to my clients the next morning. Only your "friendly neighborhood core facility" can do that. So, up the hill I go, one more time for the day. Speed is a niche we can fill. A client can submit an on-line work request for synthesis as late as 6:00 pm, just before I go home, and we'll have it ready for them when they need it in the morning

Quality is another niche for the small core facility. The inexpensive oligo vendors use high-throughput plate synthesizers. They're fast and stingy with reagents. But think about what you learned in Organic Chemistry — that's not how you optimize yield. They can't get the coupling efficiency that our good old ABI 394s can get; and even a few tenths of a percentage point matter when you're doing solid-phase synthesis. Consider Table 1.

For primers, linkers, and other standard oligos of lengths less than 30 bases, the lower coupling efficiency of plate synthesizers may not matter for most molecular biology experiments. But for longer oligos and experiments where "signal-to-noise" matters, the quality difference becomes apparent. You do get what you pay for.

In addition, we do quite a bit of non-standard oligonucleotide synthesis. That is the synthesis of oligos with modified nucleotides, phosphorothioate instead of phosphate internucleotide linkages, or other non-nucleic acid molecules coupled to the oligo. The addition of biotin and fluorescence labels for various purification and detection approaches are the most common requests. But we also synthesize models of DNA damage and other unusual molecules, such as, most recently, siRNA oligonucleotides.

A client can submit an on-line work request for synthesis as late as 6:00 pm, just before I go home, and we'll have it ready for them when they need it in the morning

Length (n)	Yield of Full-length Oligo for Average Coupling Efficiency (ACE)*		
Starting with 40nmoles	97%	98%	99%
25-mer	19.3 nanomoles	24.6 nanomoles	31.4 nanomoles
50-mer	9.0	14.9	24.4
75-mer	4.2	9.0	19.0
100-mer	2.0	5.4	14.8
125-mer	0.9	3.3	11.5

Table 1. Cumulative Effect of Coupling Efficiency
*Yield = $S*ACE^{(n-1)}$, starting material (S) is 40 nanomoles

A BRIEF HISTORY

It's curious, but current state-of-the-art oligo synthesis uses machines and chemistries that have been around for quite a while; some of the most innovative aspects dating from the late 1950s. For example, there are several reactive sites on a nucleotide, so it's crucial to control when and where reactions occur. This problem was solved with H.G. Khorana's "on-off" protection scheme. The Khorana approach calls for two types of blocking groups for the reactive positions on a nucleic acid monomer. This synthesis scheme starts at the 3' terminus and adds monomers in a reaction cycle until the final 5'-terminal nucleotide has been added. The initial monomer, at the 3' end of the requested sequence, is attached to a solid support with a

Thomas J. Keller

linkage that is susceptible to a basic reagent, such as ammonium hydroxide, hence, the name "solid-phase synthesis." The primary amines on the nucleobases are prevented from reacting with "base-labile" blocking groups. But the 5'-OH on the deoxyribose (or ribose for RNA synthesis) is blocked with an "acid-labile" blocking group. It is this blocking group that gets removed just before the next monomer is added. The solid-phase synthesis concepts grew out of earlier work on peptide synthesis by D. Letsinger. Solid-phase synthesis allows excess reagents and side products to be easily washed away without purification between the synthesis steps.

The actual coupling reaction occurs between the unblocked 5'-OH and an activated phosphorous moiety attached at the deoxyribose or ribose 3' position. M. Caruthers with S. L. Beaucage and L. McBride improved the chemistry of Letsinger and devised the cyanoethylphosphoramidite cycle that is used today for coupling and then oxidation to the natural phosphate linkage.

After all the coupling reactions have been accomplished, the completed oligonucleotide is cleaved from the solid support and the remaining blocking groups are removed by the addition of a basic solution (e.g., aqueous ammonium hydroxide) to the column and incubation in this solution for several hours. There are a number of different blocking groups and column linkers available. These dictate the type of cleavage and deprotection reaction that must be performed to end up with the unblocked, "natural" single-stranded DNA molecule.

At this point, for most applications, all we have to do is remove the organic salts — the remains of the blocking groups — with a simple size-exclusion chromatography step. Voila! A single-stranded natural oligonucleotide. The desalted oligonucleotide is ready for use by the biochemist or molecular biologist for most applications. Occasionally, more extensive purification is needed and we do that upon request as well.

An excellent, brief history of the history of oligonucleotide synthesis can be found at http://www.trilinkbiotech. com/tech/pdf/A%20Short%20History%20of%20Oligonucleotide%20Synthesis.pdf#search=%22 Nobel%20Prize%20 oligonucleotide%20 synthesis%22. Original references are cited there.

The basic chemistry cycle as implemented on the

ABI 394 is shown in Figure 1.

Each complete cycle takes about six minutes, or about ten bases per hour. The final cleavage from the column takes another hour. The synthesis product is pushed to a glass vial for an additional period of time for removal of the remaining blocking groups.

FILL THE NICHE NEEDED BY YOUR CLIENTS

Besides the researcher who needs their primers or probes ASAP, we are able to synthesize modified and labeled oligos economically. Since we are just trying to break-even and not make a profit, we only add the cost of the special reagent to our standard synthesis fee. So the modified or labeled oligos are actually quite competitive.

And, of course, we are there to help our grad students, post-docs, and faculty with experimental design and troubleshooting. We give a 100% guarantee with a rapid response to any problems.

RNA INTERFERENCE AND SYNTHETIC siRNA OLIGONUCLEOTIDES

RNA interference, or post-transcriptional gene silencing, is an ancient, conserved cellular defense mechanism that evolved to help protect against microbial pathogens by targeting exogenous RNA for degradation. It is also involved in regulating the expression of protein-coding genes in many cell types of various organisms. An excellent review can be found at a NIH National Library of Medicine website.1 The salient feature of this relatively new area of research, for synthesis core facilities, is that short, double-stranded RNA molecules (siRNA) can serve as "guides" to the sequence-specific degradation of RNA. As a tool in functional genomic studies, the RNA that is targeted is the messenger RNA (mRNA) of the gene of interest, hence, the term "gene knockdown" for this experimental approach.

During the last several years, RNA interference with synthetic siRNA oligonucleotides has became widely used as a powerful tool for studying gene expression and we are now synthesizing a lot of siRNA oligonucleotides. RNA synthesis reagents have been around for a long time. The monomers are five to six times more expensive than those used in DNA synthesis. The extra hydroxyl on the ribose has to be blocked to prevent it from reacting during the coupling cycle (see Figure 1). The blocking group is a bit bulky, causing steric hindrance, and slows down the actual coupling reaction. We get decent yields by simply allowing a longer time for each cycle's coupling reaction. The "gentle" removal of this blocking group and the sensitivity of RNA to ubiquitous RNA degrading enzymes (RNases), even present on your skin, make processing the final product more difficult. But these difficulties even the playing field for university core facilities vs. commercial vendors and provide us with a whole new niche for our synthesis service.

What makes siRNA molecules cost-effective for the academic core facility to offer is the fact that they tolerate having a terminal dTdT. That is, we can synthesize a mixed oligo with two DNA bases at the 3' terminus, and the rest of the bases composed of RNA. This makes siRNA synthesis easier and cheaper because we can use

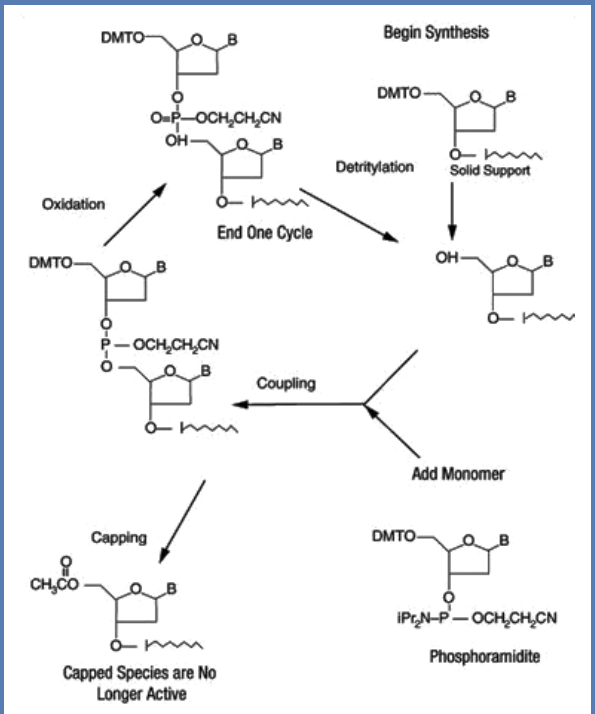

Figure 1. The extra hydroxyl on the ribose has to be blocked to prevent it from reacting during the coupling cycle.

the so-called "Low Volume" (LV) columns. These columns contain a membrane instead of CPG 2 as the solid support. The polystyrene membrane is intrinsically drier and allows the use of cycles that are stingier with the expensive RNA reagents. Therefore, the university core facility can successfully compete in the siRNA synthesis area.

"LAISSEZ LES BONS TEMPS ROULER!"[3]

Custom, synthetic oligonucleotides are used in a wide range of molecular biology experiments. They are used as "primers" for DNA sequencing and PCR (polymerase chain reaction) experiments. They are also used in oligo-directed mutagenesis and to identify specific

locations on a genome via sequence specific hybridization. Perhaps because of their ubiquitous use in modern molecular research, they have become a commodity product, much like purified enzymes became a commodity back in the 1970s and 80s. University core facilities really can't compete on price with commercial sources of primers — relatively short, unmodified oligos. We simply can't achieve the economy of scale that a high-throughput commercial vendor can achieve, and we can't use the loss leader technique of getting clients "in the door," so to speak, with cheap primers in the hope of also selling them something else that makes money. NIH rules require university core facilities to use a straightforward, break-even fee structure. For this reason, many universities have shut down their oligo synthesis facilities during the last decade.

We have found that university core facilities can continue serving their institution's researchers with high-quality oligonucleotides when speed and/or modified oligos are needed. And the discovery of RNA interference with siRNA has really rejuvenated the usefulness of university oligo synthesis core facilities. We help with the design and experimental troubleshooting as well. We began synthesizing siRNA oligos just last year, and the demand is up 75% in 2006. It has stimulated interest in our other competitive niches as well. We expect this trend to continue. So hang in there core lab managers... just keep your raincoat handy.

1. http://www.ncbi.nlm.nih.gov/genome/probe/doc/TechRnai.shtml
2. controlled pore glass, aka CPG
3. Let the good times roll.

Thomas J. Keller *has a PhD from the University of California, San Francisco in Medicinal Chemistry. In 1995, Dr. Keller came to the Oregon Health & Science University to develop a small department-based facility into a campus-wide research core facility now known as the MMI Research Core Facility. His latest endeavor is to improve informatics and data processing in the lab using Perl, BioPerl and EMBOSS. He can be reached through http://www.ohsu.edu/research/core.*

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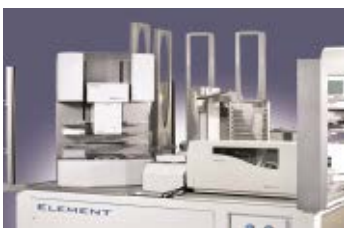

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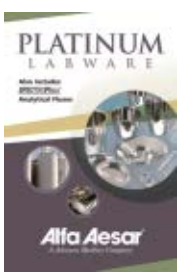

This 60-page "Platinum Labware" reference handbook and catalog outlines the selection, use, and care of laboratory ware made from platinum and other precious metals. The book includes sections that review alkali metal borate fusion fluxes, the pros and cons of many precious metals, a "care and use" section, and a reference section.
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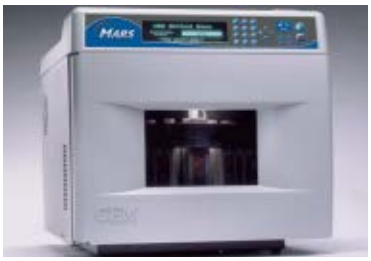

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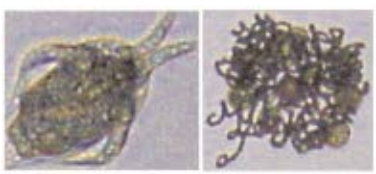

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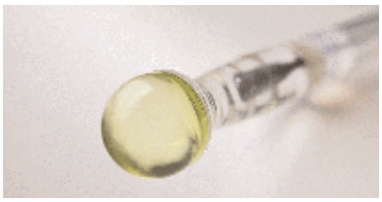
When connected to a multiparameter sensor (MPP 350), the Multi 3500i can measure and display four parameters simultaneously on the backlit graphic display. Other features include GLP-compliant calibration recording capability, 1800 data set memory, time-controlled datalogging, and bidirectional RS232 interface.
Nova Analytics, Booths SR27, 2677
www.novaanlaytics.com

CO_2 INCUBATORS

The Hotpack ProCulture 150 and 150UV CO_2 incubators were designed for critical cell culture applications. Temperature and CO_2 sensors ensure culture conditions and recovery after opening the door. It contains a UV sterilization source which performs decontamination in 30 minutes, enabling the system to be ready for operation with minimal interruption.
SP Industries, Booth 4185
www.spindustries.com

PH GLASS FORMULA



This pH glass formula, GXV, works in low ionic strength solutions as well as high pH applications. The sample pH is registered in less than 20 seconds and the pH value is reproducible over the entire pH range from 0 to 14.
Van London – pHoenix Co, Booth 1939
www.vl-pc.com

PLATE READER

The DynaPro Plate Reader makes automated dynamic light scattering measurements. It is designed to screen unfractionated samples. The plate reader also has built-in temperature control and is compatible with most liquid handling robots. It can be used with microplates of 96-, 384- or 1,536-well plates.
Wyatt Technology, Booth 1372
www.wyatt.com

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NuAire offers a complete line of polypropylene products including vertical laminar airflow fume hoods, conventional and by-pass fume hoods, polypropylene casework, acid storage cabinets, countertops, and accessories. This equipment is designed for the corrosive, semi-conductor, or metal free laboratory, constructed from all stress-relieved, fully seam-welded, white polypropylene.
NuAire, Booth 2260
www.nuaire.com

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PerkinElmer Life and Analytical Sciences, Booths 843, SR14, SR15, SR16
www.perkinelmer.com

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Two ZORBAX rapid resolution high throughput 1.8µm LC columns offer solutions for both conventional and ultra-fast separations. The StableBond phenyl column provides selectivity for aromatic compounds. The StableBond AQ column separates polar compounds in up to 100% aqueous mobile phases. Users can now choose from over 100 column configurations.
Agilent, Booths SR44, 4255
www.agilent.com

BIODIESEL GC COLUMN

The Alltech® AT™ Biodiesel column analyzes biodiesel as required by methods EN14105 and ASTM D6584. These methods determine the glycerin content produced during the transesterification of vegetable oils. The column is manufactured with a high-temperature, 5% phenyl phase, fused silica tubing, and an attached 5-m deactivated retention gap.
GraceDavison Discovery Sciences™
Booths SR02, 1413
www.discoverysciences.com

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The integrated contract development and manufacturing services include instrumentation, disposables, and custom automation. These services were designed for specialist applications, such as handling magnetic beads, microarrays and glass slides, heating and cooling, image acquisition and analysis, and design of highly integrated optics.
Invetech, Booth 4663
www.invetech.us

SOLID PHASE EXTRACTION SOFTWARE

Trilution® LH offers one software package to control all liquid handling and solid phase extraction instruments maximizes. The drag-and-drop functionality enables users to both set-up instrument configuration and define bed layouts. The software has an application run screen that provides complete control over the users run and features and import/export functionality.
Gilson, Booths SR43, 4069
www.gilson.com

GC/MS

The GC/MS-QP2010 Plus features a mass range of 1.5 to 1090 m/z, an ion source temperature range from 100 ?C to 300 °C, and dual turbo pumps. It also features automatic adjustment of retention time (AART), fast automated scan/SIM type (FASST), and creation of automatic SIM tables (COAST).
Shimadzu Scientific Instruments, Booths SR03, 1820
www.shimadzu.com

PROCESSING SYSTEM

By combining aspects of laboratory and on-line systems, the ProcessLab is a fully customized, automated system for analytical testing with up to 16 places for measuring instruments, sample loops, pumps, stirrers and other accessories. It features application-specific modules to perform titration, conductivity UV/VIS, ion selective measurements, and more.
Brinkmann, Booths SR04, 2032
www.brinkmann.com

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The LABXPERT printer is specifically designed for lab applications. Label materials withstand exposure to acids, solvents, and low temperatures. Recent upgrades include a USB port, more font sizes, and narrower barcodes for smaller labels. The printer can produce text sizes of 0.04" through 1.25" high on label sizes from 0.25" to 1.5".
Brady, Booth 3507
www.bradyid.com/lab

ANALYTICAL COLUMN

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Chiral Technologies, Booth 2462
www.chiraltech.com

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GE Analytical Instruments, Booth 2710
www.geinstruments.com

ELECTRONIC HANDHELD DISPENSERS

The Repeater® stream and XStream ergonomic handheld dispensers dispense liquids with high vapor pressure and/or high viscosity, while also preventing cross-contamination. They feature a motorized piston, intuitive programming and a one-button tip ejection system. The Xstream can also perform titrations, supernatant removal and sequential dispensing.
Eppendorf North America, Booth 1832
www.eppendorfna.com

LOW CONCENTRATION CHROMATOGRAPH

The Zetasizer Nano system has a flow mode option which enables the coupling of dynamic light scattering with size exclusion chromatography. Designed to meet the low concentration and small sample volume requirements of protein and other biomolecular applications, its optical design and sensitivity capabilities can also be applied to real time flow measurements.
Malvern Instruments, Booth 2010
www.malvern.com

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The NitroFlowLab is a self contained membrane nitrogen generator that produces 99% pure nitrogen with pressures up to 116 psig. It produces nitrogen by utilizing a combination of compressors, filtration, and membrane separation technologies. Typical applications include nebulizer gases, curtain gases, source gases, and more.
Parker Balston Analytical Gas Systems, Booth 1865
www.parker.com

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Labconco Corporation, Booth 3825
www.labconco.com

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How it Works

Capturing 2-dimensional Gel Images

Problem: Two-dimensional (2-D) gel electrophoresis is a multi-step procedure that can be used to separate hundreds to thousands of proteins with extremely high resolution. The first step involves the separation of proteins in two dimensions using isoelectric focusing in the first dimension and SDS-PAGE in the second dimension. The second step is the non-specific localization of protein spots that has traditionally been accomplished using visible stains, such as Coomassie Blue or silver, or more recently using fluorescent dyes such as SYPRO Ruby (Figure 1). The third step involves recording a high-resolution image of the gel that is typically accomplished using a scanner or CCD-based camera system. During the final step, an intensity and positional-based analysis is performed on the images to mine relevant data from the experiment. A problem arises from the fact that the best solution for each step requires using systems from different vendors. In particular, bringing images from proprietary capture system file formats into analysis software via conversion to tiff can produce noise that can impact data interpretation.

Solution: Nonlinear Dynamics Ltd, a global provider of bioinformatics solutions, developed the Progenesis platform for 2-D gel data mining and analysis, and implemented algorithms that allow users to directly import Fuji's proprietary .img file format.

Figure 1: SYPRO Ruby-stained 2-D gel image captured using a Fujifilm Life Science USA FLA—7000 scanner.

Figure 2: Progenesis software on a computer running the FLA—7000

Now, users have a complete solution for 2-D gel applications (Figure 2).

Fujifilm Life Science USA, Inc. provides a family of scanner products capable of imaging 2-D gels up to 40 cm x 46 cm in size. These systems can image proteins labeled with colorimetric (i.e., Coomassie and silver), fluorescent (i.e., SYPRO Ruby), as well as radiolabeled reporters on a single system. The ability to use up to four lasers (i.e., 473 nm, 532 nm, 635 nm, and 670 nm) as well as two photo-multiplier tubes, gives researchers the ability to easily set up multi-spectral fluorescent labeling experiments like the popular DIGE format. Fuji systems are capable of scanning gels, up to a 20-mm thickness, with scanning times for 20 cm x 23 cm areas at a 25-µm resolution in less than 35 minutes. System software file output is logarithmic and is in Fuji's proprietary .img format.

Nonlinear's Progenesis software platform now accepts the logarithmic .img file format and converts it directly using algorithms supplied by Fuji. Once a file has been converted, users can choose to process and analyze the images with one of the solutions in the Progenesis suite, depending on the staining methodology or level of functionality required. The Progenesis range allows users to automate gel processing without compromising the quality of data generated, delivering highly reliable and reproducible results. It supports the full 2-D workflow from spot detection and matching to identifying spots of interest within statistical parameters ready for spot picking and mass spectrometry.

For more information, go to fujifilmlifesciencesusa.com

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A Reading List for Leaders On Their Way to the Top

Sarah E. Needleman
From CareerJournal.com

David Fowler joined The Chubb Corp. as a management trainee after graduating from Brown University in 1967. In 37 years at the financial-services company, he held management roles in underwriting, human resources, information technology and administration, including four years as chief executive officer of the Chubb Institute Inc., an educational-services subsidiary sold in 2004.

Today Mr. Fowler is a vice chairman at WJM Associates Inc., heading the New York executive-coaching firm's advisory practice. We asked Mr. Fowler about books that helped him through his career and that he'd suggest to managers and professionals eyeing a CEO job today. Here's the list of his picks, with his comments on each:

WINNING

By Jack Welch with Suzy Welch

"The theme of this book is that if you're looking to rise to the top, no matter what job you have, over deliver. Don't worry about politics, mentors or coaches. Just over deliver, and you will rise to the top. [The author] gives great examples of what helped him do that."

EXECUTION: THE DISCIPLINE OF GETTING THINGS DONE

By Larry Bossidy (former chairman and CEO of Honeywell International Inc.) and Ram Charan with Charles Burck

"This book talks about the value of implementation and how exquisite execution is more important than a laid out strategy. It helps you focus on what's important to get a business moving forward."

LEADER SHOCK...AND HOW TO TRIUMPH OVER IT: EIGHT REVOLUTIONARY RULES FOR BECOMING A POWERFUL AND EXHILARATED LEADER

By Greg Hicks

"This book helped me deal with some of the challenges I had in my career. What I got out of it was how to deal with disappointments in business and then rebound from them."

AUTHENTIC LEADERSHIP: REDISCOVERING THE SECRETS TO CREATING LASTING VALUE

By Bill George

"The theme of this book is showing compassion, leading a balanced life and maintaining a high set of values and morals. It's especially important today because of the scrutiny that business leaders are now under."

THE ONE MINUTE MANAGER

By Kenneth Blanchard and Spencer Johnson

"This book gives guidance to managers and leaders on how to assign work and differentiate various work styles of employees. It's very useful in terms of fundamentally learning the art of delegation and the different approaches to work that employees take."

WORKING WITH EMOTIONAL INTELLIGENCE

By Daniel Goleman

"The emotional intelligence of a leader is as important as, if not more than, a person's IQ. This book can help you become more self-aware and balanced in your leadership style."

IN SEARCH OF EXCELLENCE: LESSONS FROM AMERICA'S BEST-RUN COMPANIES

By Thomas J. Peters and Robert H. Waterman Jr.

"This book encourages leaders to make sure they recognize the pride that their workers have in their products. It gets you to focus on who's really doing the most meaningful work."

THE HERO'S FAREWELL: WHAT HAPPENS WHEN CEOs RETIRE

By Jeffrey Sonnenfeld

"How you handle your exit is very important, and this books makes you think about the kind of legacy you want to leave behind. It describes the exit behaviors of CEOs and other top company leaders, and talks about how to go from being very powerful and high-profile to a retiree."

news notes

EDITORIAL BOARD MEMBER RECEIVES DISTINGUISHED SERVICE AWARD FOR ANALYTICAL LABORATORY MANAGEMENT

Dr. Wayne Collins, a member of the *Lab Manager Magazine®* editorial board, has been selected as the recipient of the 2006 Distinguished Service Award for Analytical Laboratory Management sponsored by Agilent Technologies. This annual award is presented to a single individual in recognition of outstanding performance and service to the profession of analytical laboratory management. The award was presented at the Analytical Laboratory Managers Association (ALMA) annual Conference in Portland, OR, and consists of a plaque, $3,000 honorarium, and up to $1,000 travel expenses to attend the Conference.

Dr. Collins is currently Professional Services Manager for Thermo Fisher Scientific. Previously, he was the laboratory manager for Solvay Polymers (now Ineos) in Deer Park, TX for 24 years. He has also worked as a researcher studying the free radical distribution in flames as a National Research Council-National Academy of Sciences Postdoctoral Fellow at NASA's Johnson Space Center (Houston, TX) and the chemistry and physics of explosives with Monsanto Research Corporation (Miamisburg, OH). Wayne earned a MS degree in physical chemistry from Stephen F. Austin State University (Nacogdoches, TX), a Ph.D. in inorganic/analytical chemistry from the University of Houston (Houston, TX), and a MBA with emphasis in marketing from Wright State University (Dayton, OH). He also received a commission as an officer in the US Army Chemical Corp. Wayne served as President of the Analytical Laboratory Managers Association in 2000 and continues to serve on the Board of Directors. He is currently Editor of Managing the Modern Laboratory, writes and publishes the ALMA e-News, and conducts laboratory management workshops worldwide. He was also one of the founding members of the Houston Area Lab Managers Group in 1996. He has published over 35 articles on laboratory management, 21 research journal articles, co-authored one book, and has given invited presentations at professional conferences in the US, Europe, and Australia.

The Distinguished Service Award for Analytical Laboratory Management recognizes outstanding performance and service to the profession of analytical laboratory management. It began in 2002 and is sponsored by Agilent Technologies. More information on the award and nominations can be found at www.labmanagers.org.

FIRST AUSTRALIAN LABORATORY MANAGERS CONFERENCE

Science Industry Australia (SIA), an industry trade group, organized the first Australian Laboratory Managers Conference in Melbourne, Victoria. The program included one-day management workshops prior to the start of the conference that drew over sixty participants while the conference itself drew over 120 delegates. This level of attendance at an inaugural conference with limited promotion confirmed the high degree of interest in this topic in the region, and encouraged SIA to organize a second conference to be held in Brisbane in the fall of 2007. At the end of the conference, the formation of the Australasian Laboratory Managers Association was announced as an umbrella organization to promote education and networking among lab managers. Representatives from The Royal Australian Chemical Institute attending the conference also recognized the need for a professional association and are working toward creating a division of laboratory management within their organization.

While the conference drew participants primarily from Australia and New Zealand, SIA added an international flavor by including keynote addresses by Professor Claude Lucchesi, Northwestern University (Evanston, IL), and by Dr. Wayne Collins, Thermo Fisher Scientific (Sugar Land, TX). These guests represented the U.S. based Analytical Laboratory Managers Association

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(ALMA) and explored opportunities for mutual cooperation with the new organization. While the two organizations will not be formally affiliated, both recognize that that they have common goals and have pledged to look for additional areas where they can work together to further the profession of laboratory management.

The conference sessions included topics such as improving the analytical support laboratory, people management, Laboratory Information Management Systems, regulatory and safety management, and business management. Both the presenters and the attendees came from widely diverse laboratory environments including basic chemical, mining, biotechnology, biological, medical, academic, and government research, yet they found common ground in their management issues. Overall, the gathering marked a major milestone in the advancement of professional laboratory management in Australasia.

To receive information about the next Laboratory Managers Conference in Brisbane in 2007, contact sia@scienceindustry.com.au.

PERKINELMER BRIDGES BASIC SCIENCE AND CLINICAL MEDICINE WITH TRANSLATIONAL MEDICINE PLATFORM

PerkinElmer has developed a suite of technologies in the pharmacokinetic (ADME) and toxicology testing arena to enable faster progression through the drug discovery pipeline. A combination of mass spectrometry approaches, biochemical analyses of the phosphorylation kinetic changes of proteins in the cell, as well as high-throughput instrumentation and reagents for ADME/Tox screening allow researchers a better understanding of disease processes, classification of diseases, diagnosis modeling, and treatment protocols. Biomarker analysis and multiplexed systems link drug candidates to appropriate disease targets, allowing a more rapid development workflow.

SIEMENS AND UCLA RESEARCHERS GET FDA "GREEN LIGHT" FOR CLINICAL STUDY OF ALZHEIMER'S-SPECIFIC IMAGING AGENT

Siemens Medical Solutions announced that it will begin clinical trials under an investigational new drug (IND) application submitted to the Food and Drug Administration (FDA) for an imaging biomarker that could potentially identify Alzheimer's disease prior to the onset of noticeable symptoms.

Siemens will collaborate with leading Alzheimer's researchers at the University of California, Los Angeles (UCLA) to launch a Phase I, Open Label, Single Center Safety Study of one of the first imaging biomarkers designed to identify Alzheimer's disease pathology specifically. The study will employ a new diagnostic technique developed by UCLA researchers that combines the new imaging biomarker and positron emission tomography (PET).

NIKON ANNOUNCES CELL CULTURE OBSERVATION DEVICE

Nikon Instruments Inc. announced the BioStation CT, a fully integrated, self - contained cell culture observation device and monitoring system that allows users with minimal microscopy experience to conduct live cell imaging locally or by remote operation over a public or private network. The BioStation CT provides a system for managing, observing and recording cell growth, morphology, and protein expression in culture by providing consistent environmental control of temperature, humidity, and gas concentration. The system allows numerous researchers to perform multiple experiments with the same instrument within the same period.

Applications for the Nikon BioStation CT include clinical medicine where researchers can determine the optimum selection of anticancer drug combinations; re-generative medicine for stem cell culturing and cell differentiation; biotechnology based drug development and toxicology studies; drug discovery safety testing; biotechnology research involving genome and proteome initiatives; and traditional bioscience research using multi-channel fluorescence and time lapse image recording.

NEW APPLICATION NOTE ON THE DETERMINATION OF MERCURY IN WATERS

Teledyne Leeman Labs, a manufacturer of analytical instrumentation for elemental analysis, announced the publication of a new application note for laboratories that monitor mercury in water. Mecury's mobile nature allows it to diffuse through the air, soils, and ultimately water systems. Fish have the ability to bio-accumulate mercury (in its methylated form) to 100,000 times the concentration of the waters they inhabit. As a result, fish consumption advisories are posted for over 2,000 bodies of water within the United States. Many laboratories are charged with the important task of monitoring mercury in effluent, waste, and ambient waters. This method provides details for the operation of the Hydra AA according to existing EPA methodology (7470 and 245.1). A copy of application note 1038, "The Determination of Mercury in Waters by Cold Vapor Atomic Absorption Spectroscopy", is available at www.leemanlabs.com/resources/applications.

BRUKER AXS ANNOUNCES SCHOLARSHIP WINNERS

During the 2006 Materials Research Society Fall Meeting, Bruker AXS announced the recipients of its 2006 Excellence in X-ray Diffraction (XRD) scholarships for unique applications in the categories of Materials Science and Geology and Chemistry. Hsiu-Wen Wang of the Indiana University Department of Geological Sciences, Bloomington was awarded the Bruker AXS 2006 Excellence in X-ray Diffraction scholarship for unique applications in the category of Geology and Chemistry. The title of her winning paper is "Dehydration/Rehydration Induced Phase Transitions in Natrolite." Graduate student (Ph.D.) Christian Long of the Department of Materials Science and Engineering and Center for Superconductivity Research, Department of Physics at the University of Maryland was awarded the 2006 Bruker AXS Excellence in X-ray Diffraction scholarship again this year for unique applications in the category of Materials Science. His paper is entitled "Rapid Structural Mapping of the Ternary Metallic Alloy Systems Using the Combinatorial Approach and Cluster Analysis."

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Glenn Ketcham, CIH and Vince McLeod, CIH

The Last Line of Defense – PPE

In days of old when battles were fought with swords, arrows, and spears, warriors often wore armor for protection from an enemy intent on doing them harm. The armor they wore could sometimes be effective but it could be defeated and serious injury or death could still occur. The selection of armor determined, in part, the effectiveness. For example, chain mail would have no value against a blow from a mace but a shield might offer good protection if used properly. One's chance of survival improved much more so if a castle wall was added between the invading army and the defenders. Where castle walls were not feasible or during the time they were being built, it was much better to be a soldier with proper armor (and knowing how to use it) than not.

Fast forward a thousand years to today's laboratory and we find these basic concepts still remain — and are in fact built into current OSHA standards (29 CFR 1910 Subpart I - 1910 Subpart I, Personal Protective Equipment). OSHA requires the first line of line of defense against workplace hazards to be engineering controls (our castle walls). Controlling a hazard at its source is the first choice because this method can either eliminate it from the workplace altogether or isolate it from the worker. These controls might include: ventilation controls (fume hood, gas cabinets, differential room pressures), equipment and container guarding or enclosures (e.g. glove boxes, radiation shielding), hazardous product substitution, or sometimes even adjusting scale or temperature of reaction. Engineering controls remove the hazard or keep the hazard from impacting us. Our personal protective equipment (PPE) should be considered our last line of defense because it means the hazard has actually made it to us and without the PPE injury may very likely occur. PPE would include items such as respirators, gloves, lab coats, boots, face shields, goggles, hearing protection, etc.

From a good practices (and OSHA) perspective one must use engineering or administrative controls over the use of PPE unless one can demonstrate engineering controls are infeasible. One may also use PPE during the interim period where a hazard is discovered and engineering controls have not yet been installed. OSHA says:[1]

> "Employers are required to determine if PPE should be used to protect their workers. If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness."

OSHA requires documentation that the equipment selection is based on the hazard, that employees have properly fitted equipment, they are trained on the equipment assigned, and that the equipment is kept in good repair. A good PPE program also includes a monitoring aspect of the program to ensure the equipment used is still appropriate for the job and that the employees are actually wearing and maintaining it properly.

Let's take a look at these elements individually.

Workplace Survey/Experimental Design Evaluation: Job Hazard Analysis (JHA), as it is known in industry, is the first step in identifying hazards and controls. It is through this process where one assesses the potential risks associated with a particular task, process, or job and devises ways to control or eliminate them before an injury or accident occurs. The technique focuses on analysis of the individual tasks or steps associated with a job and the identification of controls for the hazards in each step. PPE must be used when the hazard cannot be removed or controlled adequately (such as acid-washing glassware) or when PPE use is required by specific regulation or federal guidelines (such as working with BSL-2

agents). The hazards should be identified in the chemical hygiene plan and addressed in the laboratory specific standard operating procedures (SOPs). In some situations, determining noise exposure or exposure to toxic materials where air sampling may be required is often best conducted by a health and safety professional.

Selection of appropriate PPE: Many labs use an approach where each body area is considered from a PPE perspective: eyes, face, head, hands, feet, ears/hearing, respiratory system, and whole body. Using the acid-washing example, the JHA might identify eye hazards (chemical splash), chemical splash to the body, face/head and hands. Protection from splash into the eyes and face might be accomplished using chemical goggles and a face shield. Long gloves would be selected that prevent skin wetting and contamination by the acid wash. The glove selection should include consulting chemical compatibility charts (available from all major chemical glove manufacturers or distributors) before a decision is made. A chemically resistant apron would also be appropriate in this instance. Employees should also be given a choice, where possible, of several different PPE options (that meet the safety requirement) based on personal comfort and preference. OSHA provides good assistance through the use of eTools and other guidance.[2,3]

Fitting: If PPE does not fit properly its effectiveness is often drastically reduced. If you have safety glasses that slide down your face because they are too large, protection is lost. Respirators must fit properly or they are ineffective. There are respirator fit test methods using specialized equipment to quantitatively assess fit or challenge tests where isoamyl acetate, saccharin, Bitrex, or irritant smoke is used. Gloves may be too large, creating entanglement hazards, or may be too tight, reducing circulation or causing fatigue. Once the proper fit is identified, it should be in the employee's records.

Training: Workers need to know:

- When PPE is necessary — what jobs or areas require use of PPE?
- What PPE is necessary — all the PPE required for specific tasks
- How to properly put on, take off, adjust, and wear their assigned PPE
- Limitations of the PPE — for example, gloves don't protect against all materials equally well. You wouldn't want someone wearing latex gloves for protection against carbon disulfide or a dust mask for protection against solvent vapors. There have been injuries and fatalities resulting from misunderstanding on the limits of PPE use.
- Proper care, maintenance, useful life, and disposal of the PPE

Someone who really understands these key points and can answer questions accurately should conduct training. The workers should walk away from training with a good understanding before being allowed to conduct work requiring the use of PPE. This should not be a "paperwork exercise." OSHA inspectors will often quiz workers to see if they understand why they are wearing PPE, the hazards they are protecting themselves against, and how they care for and store their equipment.

Maintenance: All too often we see old, damaged, and potentially dangerous PPE used or stored by employees. Examples include dirty, misshapen respirators with ancient cartridges or missing valves, glasses or goggles so scratched one could not imagine wearing them, contaminated gloves or lab coats, etc. PPE must be taken care of to adequately protect the worker. Poorly maintained and cleaned equipment can actually put workers in greater danger. Making sure that equipment is properly maintained is a key component of the program.

Monitoring of the program: As PPE is the last line of defense for workers, it is very important to audit the program on an ongoing basis. This would include thorough investigation of any accidents or near-misses involving the use or lack of PPE. Monitoring in a lab is often easier than some other industries as the lab manager has the luxury of observing the staff and students on a daily basis as they go about their daily tasks. Don't let bad habits become ingrained in the lab culture.

OSHA provides some excellent resources and links on their website (www.osha.gov). Equipment vendors and technical support people can provide information on specific protective equipment. Many people equate safety with PPE. It can be very effective in preventing injury but it is also the most vulnerable to failure as it relies on people to consistently and properly use the PPE each time.

Resources:

1. http://www.osha.gov/SLTC/personalprotectiveequipment/index.html
2. http://www.osha.gov/SLTC/etools/respiratory/respirator_selection.html
3. http://www.osha.gov/SLTC/etools/eyeandface/index.html

Glenn Ketcham *is a Certified Industrial Hygienist with 22 years experience in the health and safety field. He is currently the Risk Manager for the University of Florida with responsibility for the loss prevention, ergonomics, disaster preparedness, and the occupational medicine surveillance programs. He has managed the laboratory safety programs for both the University of California, San Diego (UCSD) and the University of Florida. In addition, he served as an industrial hygienist with federal OSHA compliance and has a masters degree in environmental engineering sciences with a health physics concentration.*

Vince McLeod *is a Certified Industrial Hygienist and the senior IH with the University of Florida's Environmental Health and Safety Division. He has 17 years of occupational health and safety experience in academic research with focus in the research laboratory. His specialties are in hazard evaluation and exposure assessments.*

The Safety Guys welcome your comments and questions. You can email them at thesafetyguys@labmgr.com.

Business Meeting Basics

Meetings can be an excellent opportunity to get noticed, create allies, and participate in team efforts. Yet many researchers tend to sit passively during meetings and let decisions be made without their participation. How can you participate constructively and help achieve meeting objectives while using meetings as an arena to boost your reputation?

PREPARING FOR THE MEETING

Be familiar with the meeting subject and agenda. This will enable you to prepare by thinking about the subject and possibly reading background material. You will better understand how you can participate and contribute.

Dress appropriately. For example, as a researcher meeting with engineers in a paper mill, I will wear a golf shirt or sports shirt and casual slacks because jackets and ties are definitely out of place there. However, business dress is usually the most appropriate attire for high-level corporate meetings.

Arrive on time and choose a strategic seat. Sit near your supervisor to show support. Latecomers and people who oppose the boss or the subject of the meeting often will sit far away from the boss or meeting organizer. If your boss is not there yet, choose a seat that will give you a good view of any visual aids that will be used. Try to choose a seat toward the middle of the table where you will have the maximum number of neighbors and be at the center of the discussion action.

PRACTICE ACTIVE LISTENING

Active listening is an important teamwork and meeting skill. Follow presentations and discussions closely. Asking pertinent questions at appropriate points and nodding to indicate understanding all serve to show the presenter and other attendees that you are an interested participant in the meeting.

Asking questions indicates your interest and serves to obtain additional information. Avoid asking questions in an abrasive or overly aggressive way. Open-ended questions, often beginning with the words how, why, or what, usually prompt an extended response. Asking open-ended questions often helps to settle major issues and define options.

Closed-ended questions, that often begin with who, which, or when, usually solicit a relatively brief response. They are best used to solicit very specific information and as a process check to be sure you understand a previous answer.

Speak up at appropriate points to ask questions or state your own views. Speak distinctly. Nervousness has a tendency to make you speak rapidly, often in a low tone. Be aware of your poor speech behaviors and guard against them.

When you speak, be concise. Other attendees will lose interest while you make long, poorly organized statements. If possible, mentally prepare an organized statement. For example, starting with "I think there are three factors to consider" will guarantee your audience's interest as listen to learn what these three factors are.

Body language can also indicate interest, support, and understanding. Sit upright and lean toward the table. Look at the person speaking and make frequent eye contact.

Avoid negative body language such as crossing your arms across your chest, frowning, or gazing into space. Don't slouch in your chair or lean back from the table. These behaviors indicate opposition or lack of interest.

BE OPEN-MINDED

When listening to others, being patient helps them to feel they are participating without thinking that you are trying to take over the meeting and "railroad" others into accepting your point of view.

Be open to opposing points of view. Don't go into a meeting with your mind made up before hearing others' opinions. There may be a significant factor you haven't considered. This will help you be on the "winning side" more often.

In the interest of group harmony, once a decision is made, go along with it even if you disagree. When you disagree before a decision is made, never apologize for your position or become emotional. Rely on facts. However, opposing prevailing logic too often can create a reputation that you are an unsupportive, negative person.

John K. Borchardt

Application Note

A Comparative Analysis of Ultraviolet Light vs High-Heat Sterilization in a Cell Culture CO_2 Incubator

The SafeCell™ UV sterilization system process arrests and destroys contaminants within the incubator chamber and compares favorably to high-heat sterilization at +90 °C and +140 °C.

In 2001, SANYO Electric Biomedical Co., Ltd. (Osaka, Japan) introduced a cell culture CO_2 incubator, which employs an isolated narrow-bandwidth ultraviolet light to destroy airborne contaminants in the incubator chamber, as well as water-borne organisms in the humidity water reservoir. In 2006, comparative testing performed by a certified independent testing laboratory* suggests that the SANYO ultraviolet light sterilization process is as effective against bacteria, yeasts, and molds as high-heat sterilization at sustained temperatures ranging from +90 °C to +140 °C offered in competitive products. Additionally, the model MCO-18AIC-UV CO_2 incubator isolates the UV light emission from cell cultures during normal operation to permit sterilization of the internal atmosphere following routine door openings without damaging cell cultures, a process that cannot be replicated with a heat sterilization technique.

Model MCO-18AIC-UV CO2 incubator, 6.0 ft3 (170 L) with integrated UV light decontamination system and copper-enriched interior surfaces.

CONTAMINATION SOURCES

Typical incubator contaminants include bacteria, yeast, and mold. Although most cell culture work is performed in a biological safety cabinet, such contaminants cannot be eliminated during transfer, nor can they be totally reduced by adding expensive antibiotics to culture media, or chemical algaecides and fungicides to the incubator chamber surfaces and humidity reservoir. In general, unless work is being performed in a Class III environment, laboratory investigators accept the fact that some migration of airborne contaminants into the incubator chamber is unavoidable.

ALTERNATIVE TO HEAT STERILIZATION

Manufacturers of laboratory incubators claim to solve contamination problems with various approaches to incubator design. Some of these operational techniques are moderately successful but most require periods of downtime during which cultures must be removed and placed in other incubators to maintain temperature, humidity, and CO_2 levels. The need for continued protection during the cell culture process is acute. Following years of research and testing, SANYO Electric Biomedical Co. introduced the SafeCell™ UV sterilization system (U.S. patent no. 6,255,103), a sterilization technology described as Active Background Contamination Control™. This process arrests and destroys contaminants within the incubator chamber, and also compares favorably to high-heat sterilization offered by leading industry competitors at +90 °C and +140 °C.

UV STERILIZATION EFFICACY

The UV system is based on an isolated, narrow-bandwidth (253.7-nm) ozone-free ultraviolet lamp interlocked with the incubator door. The interior comprises copper-enriched stainless steel components. A directional airflow and containment plenum surrounds the UV-exposed humidity reservoir in a removable, stainless steel pan. The multifaceted approach to contamination control is designed to destroy airborne particulates introduced during door openings, as well as contaminants that grow in the water reservoir.

OVERNIGHT OR EVENT UV STERILIZATION

Independent testing confirms that the UV sterilization technique is equally effective against contamination as conventional high-heat sterilization over a range of +90 °C to +140 °C. During overnight or event sterilization of the incubator chamber, all interior components are removed for autoclaving, exposing all interior surfaces to ultraviolet light. Ultraviolet light affects DNA by causing pyrimidine dimers to form when adjacent pyrimidine bases on the DNA strand become covalently linked (i.e., chemically bonded to one another). The dimer disrupts the normal replication of the DNA or transcription to make proteins and destroys contaminants.

SAFETY AND EFFICIENCY OF UV DURING IN SITU OPERATION

During normal operation when cells are being incubated within the chamber, the UV lamp is visibly isolated from the cell culture chamber by a plenum cover over the humidity pan, permitting UV sterilization of circulated, humidified air and humidity pan surface water to remain in process without damaging the cells.

ACTIVE BACKGROUND CONTAMINATION CONTROL

Together with the passive resistance of copper-enriched stainless steel, the active effort to destroy airborne contaminants in vitro forms an effective Active Background Contamination Control unique to the SANYO incubator with UV sterilization function. As the cell culture process proceeds in the incubator chamber, the work of germicidal protection from airborne organisms continues unabated without costly downtime. This protection extends to thermophilic organisms as well.

**Independent test results. Independent testing funded by SANYO E&E America Co. and performed by Celsis Analytical Services, St. Louis, MO. Detailed test results are available at www.sanyobiomedical.com/beattheheat.*

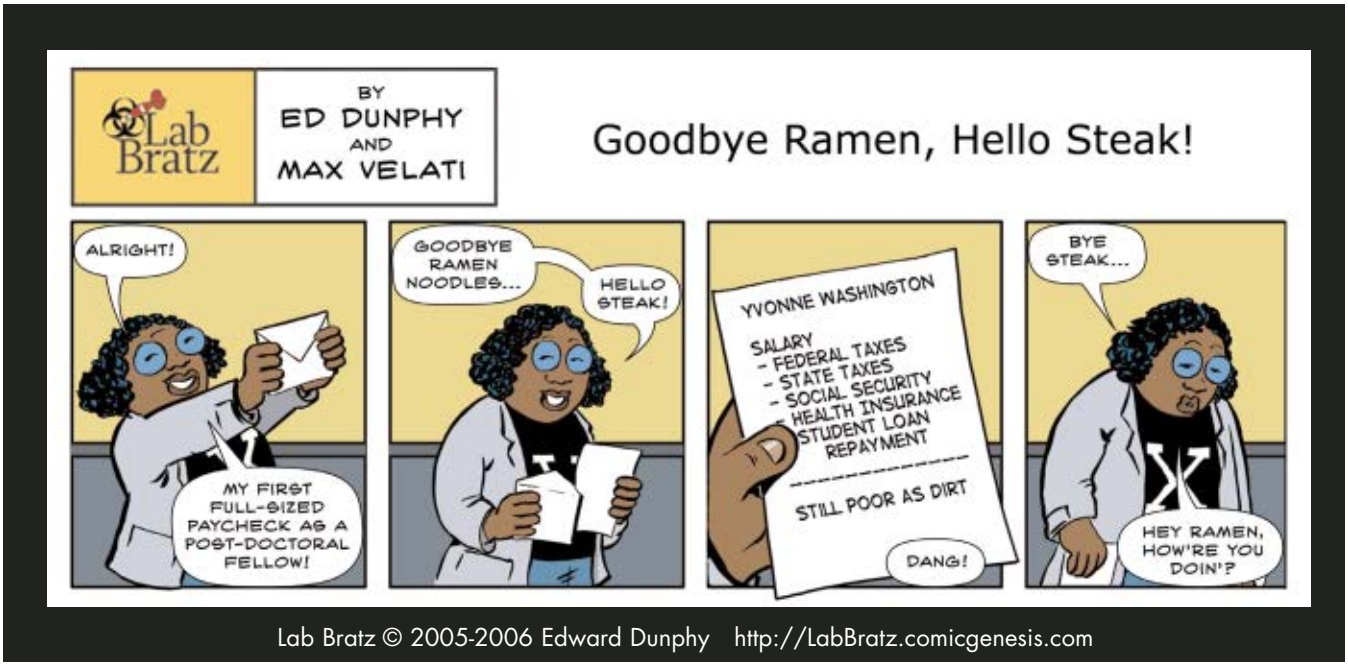
SANYO Electric Co., Ltd.
Osaka, Japan.
For more information contact:
Deepak Mistry, Marketing Manager,
SANYO E&E America Co., 1062 Thorndale Ave., Bensenville, IL 60106, U.S.A.; 800-858-8442; dmistry@sss.sanyo.com.

Organism	Bacteria							Yeast	Mold
	Enterococcus faecalis	Escherichia coli	Pseudomonas aeruginosa	Salmonella typhimurium	Bacillus subtilis (6633)	Bacillus subtilis (control)	Bacillus stearothermophilius (control)	Candida albicans	Aspergilius niger
Control Count	89,000 cfu/ml	290,000 cfu/ml	300,000 cfu/ml	360,000 cfu/ml	10,000 cfu/ml	44,000 cfu/ml	23,000 cfu/ml	9,000 cfu/ml	5,000 cfu/ml
SANYO MCO-18AIC-UV, Ultraviolet Light @ 253.7nm									
Log Reduction	>4.5							>2.9	>2.7
Elevated Heat at 90°C									
Log Reduction	>4.5							>2.9	>2.7
Elevated Heat at +140°C									
Log Reduction	>4.5							>2.9	>2.7

If you feel you find yourself in opposition to decisions too frequently, it is a good idea to consider whether you are truly compatible with the prevailing corporate culture. Find out if your team leader or supervisor thinks you are in opposing positions too often. It may be that there is a deep-seated compatibility problem and you should seek employment in another department or another company. Also, find out if your supervisor thinks you are being abrasive when speaking in opposition.

These techniques are also useful in meetings with customers and suppliers, during professional society committee and governance meetings, and during question periods after technical presentations.

Dr. Borchardt *is a consultant and technical writer. The author of the book "Career Management for Scientists and Engineers," he writes often on career-related subjects. He can be reached at jkborchardt@hotmail.com.*



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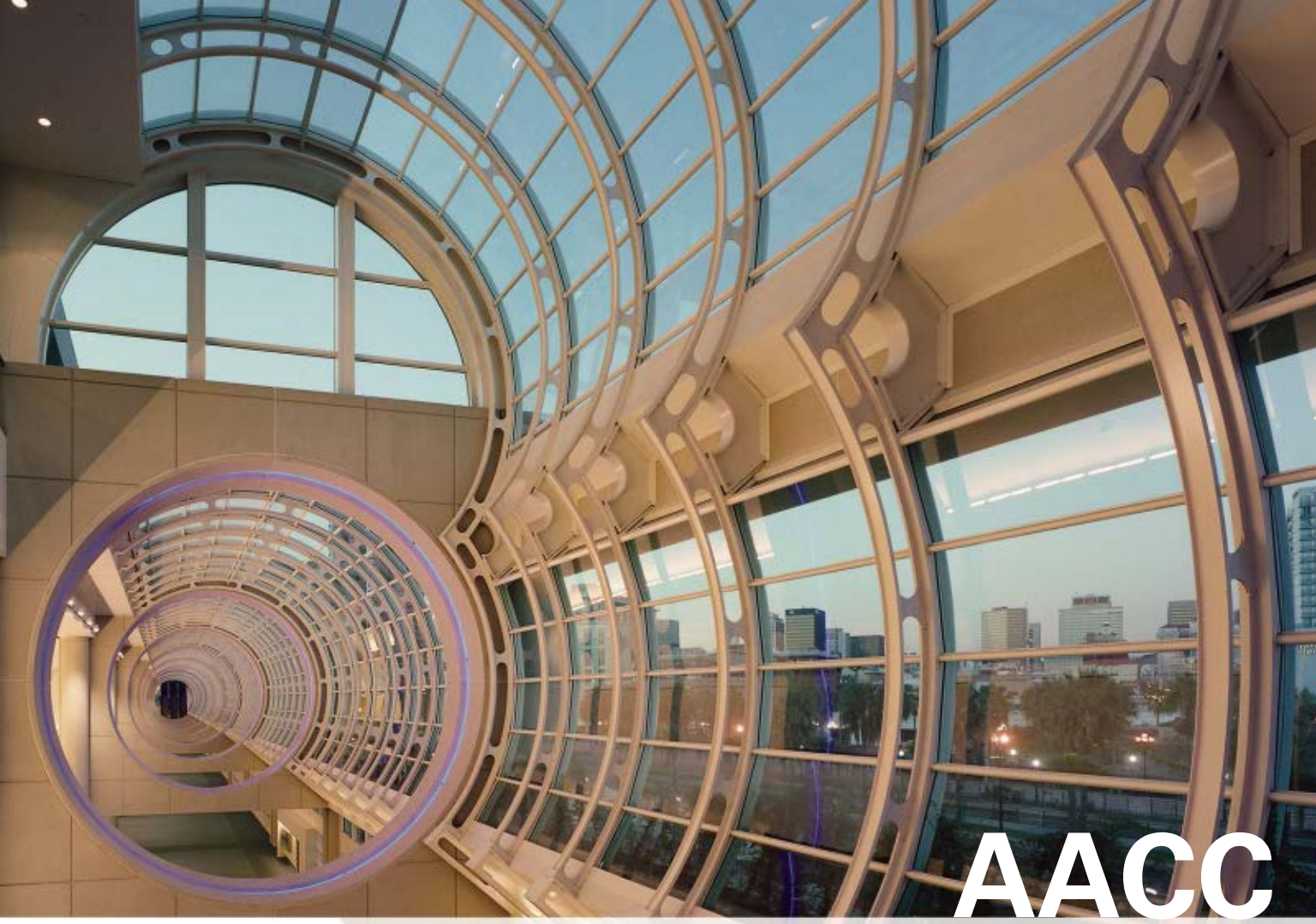

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education networking exposition

Philip Stewart
Boston Site Manager
PerkinElmer LAS

In 1977, aspiring chemist Phil Stewart seemed well on his way. An ad in the Boston Globe led to a job as a production chemist for Boston-based New England Nuclear Corporation (NEN), a leading producer of specialized biomedical products.

But a funny thing happened en route to an illustrious lab career; "early on," he discovered "I would never be a great bench chemist." And so, a manager was born.

Stewart bulked up his knowledge of "the management piece — the theory of manufacturing and continuous improvement." He devoured the writings of the legendary quality control patriarch William Edwards Deming, who pioneered the application of statistical methods to industrial production during the mid-20th century. Gradually, he acquired the requisite people skills, and learned managerial moxie from workplace mentors.

Now 50, Stewart is Boston Site Manager for PerkinElmer, Inc., whose life science arm manufactures products for drug discovery and genetic screening, including 4,000 radioactive and non-radioactive reagents under the NEN brand. He also oversees PerkinElmer's satellite manufacturing sites in Billerica, MA, Montreal, and Groningen, Netherlands, responsible for all manufacturing, shipping and distribution, facilities maintenance, regulatory compliance, and safety and quality systems operations.

Under his watch, the company's Life Science arm has racked up its share of wins, returning "consistent six to 10 percent net cost productivity in a declining sales environment," streamlining process flows, and surpassing 97 percent on time delivery to customers while decreasing inventory costs substantially over the last three years. But few topics — besides his beloved Boston Red Sox, which he honors with season tickets — excite Stewart like continuous manufacturing improvement.

"The ability to see continuous improvement is attractive. There is a rigidity and formality to manufacturing…clear metrics you can watch over time; when you make changes, you can see the impact. Whereas R&D rewards folks for new products and breakthroughs, manufacturing rewards you for making the same stuff every time, often over a period of years. Sounds boring, but it has its own challenges I enjoy."

Although others had a hand molding Stewart's managerial ethos — whether educating him on the need for a communication to "hold its intent as it's passed along" down the line, or the value of process R&D — none govern his thinking like the Iowa-born Deming, whose precepts first revolutionized Japan's auto and electronics industries during the 1970s before gaining traction in corporate America in the form of product quality systems like Six Sigma. Stewart documents PerkinElmer's Six Sigma program as saving millions over three years, "and quality improvements visible to our customers every day. But when times get tight, it's the first thing lots of companies downsize. That's shortsighted.

"Early in my career, we used to talk about complaints as a percentage of orders. Now our quality metrics look at Defective Parts per Million, which also pays off in reduced rework and scrap costs.

"The single biggest thing I got from Deming was to make decisions based on data. Far too often, folks assume. Deming also pointed out that people always try to do the right thing. If they are making errors, like producing out-of-spec product, they don't have the right tools or training. Deming correctly stated this is management's primary role — to supply correct resources and training."

Nothing trained Stewart for moving from hands-on lab work into middle management — "the toughest transition in my career. It takes patience; you go from 'Let's change this by Friday' to taking the long view. And the actions taken are not always what you envision. It took a while to appreciate there was often a better result." He also had to develop financial acumen, learning to "convert our needs into actions chemists and biologists can understand," like lab reductions of expensive radioactive waste.

Stewart advocates cross training "to allow the free transfer of knowledge" and to "keep people from getting too stale or too comfortable," and believes "the outside eye is very beneficial. Folks outside the immediate operation sit in on project improvement teams. We start with the premise no question is too stupid and go from there." His managerial style "empowers" employees, while establishing high expectations, clear boundaries and feedback loops.

Francis Key Kidder *started out as a journalist before moving on to politics and government relations, where he still keeps his hand in writing. He may be reached at 410-828-6529; info@labmgr.com.*

F. Key Kidder

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