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Lab Manager MAGAZINE®
Run Your Lab Like a Business

February / March 2010 Volume 5 • Number 2

MOVING FORWARD

SECOND ANNUAL INVESTMENT CONFIDENCE REPORT REVEALS CAUTIOUS OPTIMISM

Selling Ideas to Upper Management

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MAGAZINE
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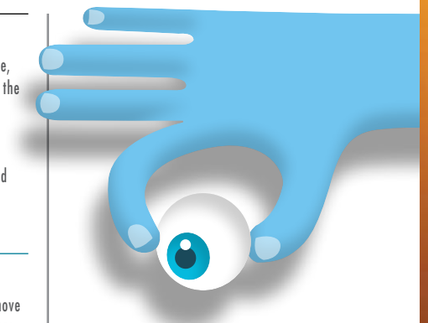

SURVEY SAYS:
Today, more than ever, it is vital that lab managers spend their funds wisely and generate maximum ROI for their labs. To that end, *Lab Manager Magazine* is conducting laboratory equipment surveys designed to help managers choose the best vendors and products for their research needs. Visit the "Laboratory Equipment Surveys" link on our home page to take a three-minute survey on the lab product of your choice—either as a "user" or "buyer."

Lab Manager MAGAZINE
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Swimming, Not Sinking

"After a year of caution and conservatism, many lab managers, regardless of whether they are optimistic or pessimistic about the future, seem to believe that it is time to sink or swim and will therefore be taking an aggressive approach in 2010."

So says Richard Daub in this month's cover story. Based on results of our 2010 Investment Confidence Survey as well as first-hand interviews with lab managers, the article provides insights from survivors of the economic tailspin and shares their plans for the future. Renewed optimism, new strategies for success and a competitive spirit seem to be the guiding principles for many research organizations.

Not denying or downplaying the very real and difficult challenges of this past year, we at *Lab Manager Magazine* are also moving our attention forward. In this month's issue we feature a number of articles that focus on attitude-changing ideas that may improve both your lab and yourself. Begin by "coloring outside the lines" (page 68) which, according to author and presenter Jeff Tobe, is a metaphor for unleashing your creativity and challenging "the way things have always been done" in order to move your organization ahead of the competition.

In his article "Selling Ideas to Upper Management," (page 40) John Borchardt tells readers to tap into the same creativity they and their staff used to conceive good ideas in order to sell them. He then takes us through the steps required to get the important management buy-in. Failure to accomplish this, he says, is the main reason excellent ideas fall by the wayside.

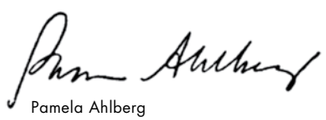
Rich Pennock, in this month's "Science Matters" column, reminds managers that to succeed in spite of global economic challenges they need to innovate, and offers four tested methods to do just that.

Shanya Kane, in a transcript of the speech she delivered at the recent ALMA meeting in Atlanta, tells lab managers that they "will eventually have no choice but to take action to increase productivity as resources are further reduced and workloads continue to increase."

She recommends three levers to boost productivity: improved processes, improved labor effectiveness, and technology. We hope that in all of this month's feature articles you find ideas and inspiration to move your lab forward.

Also included is our second "Ask the Expert" feature in which Dr. Hakim Djaballah, director of the High-Throughput Screening Core Facility at Memorial Sloan-Kettering Cancer Center in New York City, talks to Tanuja Koppal about his experiences setting up a screening lab in an academic environment. Next month's expert will discuss how to choose PCR reagents. Please visit www.labmanager.com to submit any and all questions on this and future topics.

Lastly, within the heart of our February/March issue you will find everything Pittcon 2010—from a preview of the products being showcased in Orlando, to a history of the conference itself, to "must see" product introductions. Our intention is to give you a head start on your Pittcon experience which, we hope, will include a visit to *Lab Manager Magazine's* booth to say hello. I look forward to seeing you there.



Pamela Ahlberg
Editor-in-Chief

In the January 2010 cover story, "The Online Lab Manager," the Labtronics' Nexxis iLAB was incorrectly referred to as an "integrated LIMS product" when, in fact, it is a laboratory integration product.

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MOVING FORWARD

THIS YEAR'S INVESTMENT CONFIDENCE REPORT REVEALS GLIMMERS OF HOPE by Richard Daub

Few will deny that 2009 was a brutal year for laboratories. Layoffs, cutbacks, dwindling research funds and the fear of an uncertain economic future were among the issues that organizations had to deal with—from upper management down to the trenches of the lab.

Now, however, with the economy slowly beginning to creep back to life, 2010 is offering a glimmer of hope to many lab managers. Our second annual confidence survey revealed that there is growing optimism about the future, and many feel that investment in research and development is going to significantly improve sooner rather than later. After riding out the last few months of 2009, the survivors stepped up to the starting line of 2010 ready to sprint off the blocks and pick up where they left off before the economy interrupted and threw everything out of whack.

"Relative economic stability is now allowing business forecasts to be made and plans to be put into motion."

Perhaps the most hopeful sign that things have already improved is that layoffs for the most part seem to have ceased. And because the trend for industry and institutional laboratories during the economic crisis was to cut costs as much as possible, which for many included layoffs to bring staff sizes down to the bare minimum, even a small amount of growth may prompt immediate hiring.

One of the major reasons the economic downturn was so swift and severe was that a wave of fear created by the uncertainty of not knowing how long the recession would last prompted nearly every organization in the world to cut spending. Heading into 2009, nobody seemed to know what was going to happen next. By the end of the year, however, it became apparent that the economy was not likely to take another steep nosedive.

Confident or not

Now that economic stability has been achieved, the uncertainty that drove laboratories to cut spending has subsided but has not disappeared completely. Going into 2009, 35 percent of our survey participants indicated that they did not know if their market sectors would be robust enough to support or attract significant research and development investments. Going into 2010, only 18 percent said they didn't know. And while confidence increased from 42 percent in 2009 to 51 percent, the not-confident group also increased from 23 percent to 31 percent.

These results seem to indicate that companies and organizations now have a better understanding of where they are and what they need to accomplish to begin moving forward again. Whether the outlook is good or bad, the relative economic stability is now allowing business forecasts to be made and plans to be put into motion. Behind the numbers, the mood seems to be one of cautious optimism stemming from a weariness of being stuck in the economic mud and a loss of patience from sitting and waiting for the economy to improve. Now, here at the dawn of a new decade, there seems to be a new determination to move forward regardless of what is going on in the world, which may be the kick in the butt that the economy needs to resume levels of significant growth.

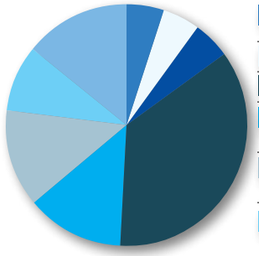
"I'm guardedly optimistic," says Miguel Suderman, president and chief science officer at Cell Systems 3-D in League City, Texas. "I am seeing some things opening up. I was recently at a conference and people seemed to be more excited about the potential for research and devel-

opment and that there is going to be more R&D money being pushed into the marketplace."

The main reason for Suderman's optimism is that private bio foundations, which in recent years have been an increasingly important fund provider for scientific research and development, had much of their money invested in various markets that declined sharply when the economy began its free fall. Now that the markets are on the mend, these foundations are in better positions to start funding projects again.

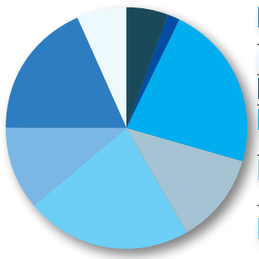
R&D BUDGET ALLOCATIONS: 2009 VS. 2010

How will your organization's 2009 R&D budget be allocated?



- *Education (training, industry meetings, information databases, etc.)* ***5%***
- *Outsourced services* ***5%***
- *Management & staff compensation* ***36%***
- *Facilities (lab construction/modernization, lab furniture, utilities, etc.)* ***13%***
- *Raw Materials (chemicals, reagents, metals, other materials)* ***13%***
- *Commodity/Consumable Products (glass & plasticware, filtration membranes, pipettors, gloves, etc.)* ***9%***
- *Technology (equipment/instruments/ systems, including related service & maintenance)* ***14%***
- *Other* ***5%***

How will your organization's 2010 R&D budget be allocated?



- *Education (training, industry meetings, information databases, etc.)* ***7%***
- *Outsourced services* ***6%***
- *Management & staff compensation* ***24%***
- *Facilities (lab construction/modernization, lab furniture, utilities, etc.)* ***13%***
- *Raw Materials (chemicals, reagents, metals, other materials)* ***24%***
- *Commodity/Consumable Products (glass & plasticware, filtration membranes, pipettors, gloves, etc.)* ***12%***
- *Technology (equipment/instruments/ systems, including related service & maintenance)* ***20%***
- *Other* ***2%***

Of course, not everyone shares Suderman's optimism. Dr. Rudolf Mueller, director of medicinal chemistry at Cortex Pharmaceuticals in Irvine, Calif., saw his company let go half of its staff in March 2009, leaving it with only 13 employees. Mueller hopes that there will be no need for additional layoffs in the coming year, but his confidence has understandably been shaken. However, if Cortex is able to raise money through the sale of some of its patents, it may be able to begin hiring again. But the sale of the patents needs to happen quickly and for the right price.

"Right now I'm not so confident," he says. "I wish I could be more confident, but it looks shaky. When you see how many people were let go by the big pharma companies, it's not so positive. Most of the research science is gone, and we have only a couple of researchers left in order to save money. If we get more money, we will definitely hire people. But that's unclear. It really depends on how things go in the near future. We just need to raise more money to start everything up again."

For a global perspective, go to www.labmanager.com/confidence/global

After a year of caution and conservatism, many lab managers, regardless of whether they are optimistic or pessimistic about the future, seem to believe that it is time to sink or swim and will therefore be taking an aggressive approach in 2010.

"You have to be aggressive," Suderman says. "You can't sit back and say, 'Why put three months' worth of hard effort into writing a grant that might not get funded?' You can't take that attitude. You have to continue to seek new markets, new networks, new contacts."

"We will be more aggressive, for certain," says Dr. Ted Lewis, CEO and lab manager of Missouri Fuel and Biowaste in Sikeston, Mo. "If the market is down, that's the best time to get ahead of the rest of the group. It's like a bicycle race. When everybody is drawing back and starting to coast, that's the time to pump real hard. That's when you make strategic steps forward. To coast and watch to see what happens is the wrong philosophy."

Used equipment purchases

Some have even seen the downturn of the economy as an opportunity to find good deals on lab equipment. While our survey revealed that the purchasing of used research and development equipment was a common practice before the recession (this year, 68 percent indicated that their research and development equipment and instruments were new, and 32 percent indicated they bought used; last year it was 67 percent new and 33 percent used), there were some enticing deals on used equipment that for some were just too good to resist.

"Because of the fallout from the economy, we've seen some deals for equipment that we didn't really have to have right when we bought it, but since the price was

good, we bought some things," says Dr. Robert Streeper, who with Dr. Elzbieta Izbicka co-own BTNS, a small laboratory in Marion, Texas, that is currently evaluating a novel anti-inflammatory/anti-infective drug. "We just consider it smart shopping."

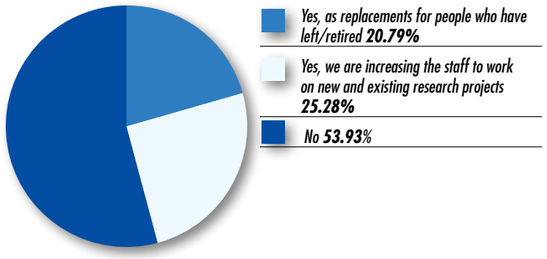
"We did actually buy quite a bit of used equipment," says Dr. Gary Hodges, a professor and researcher at the University of Western Ontario's School of Kinesiology in Canada. "We find that that works very well. It's honestly about 10 to 15 percent of the actual cost, and it's less than a year old. It's kind of shocking."

In terms of cost-saving measures, there was perhaps no more damaging result of the economic downturn than job losses and compensation reductions.

Hiring

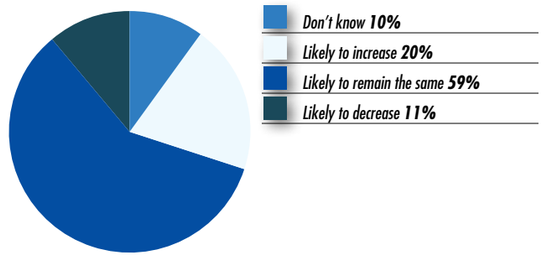
While survey participants were more confident that the overall market will see improvement in R&D investment, they were less confident that there will be adequate funds to hire enough staff and compensate them appropriately. Confidence rose slightly from 29 percent last year to 33 percent going into 2010, but the not-confident group swelled from 37 percent to 53 percent. The group that reported that they didn't know decreased from 34 percent to 15 percent. *For detailed data on R&D resource allocation, go to www.labmanager.com/confidence/rd*

IS YOUR ORGANIZATION HIRING NEW PEOPLE FOR THE LAB?



While hiring additional employees to supplement thin staff levels may become necessary if business picks up even slightly in 2010, it does not seem to be a priority. The survey participants indicated that if they were to receive additional funding from grants, 12 percent said that they would hire additional staff. Thirty percent indicated that they would fund new research projects, while 20 percent would use the funds to accelerate the process of ongoing research. Twenty-eight percent indicated that they would purchase additional scientific equipment, and 11 percent would modernize their existing facilities or begin construction on new ones.

TOTAL NUMBER OF R&D STAFF MEMBERS: 2009 VS. 2010



Outsourcing

Before the recession, outsourcing as an alternative to hiring additional employees was an increasingly popular way to keep costs down. Therefore, it seems logical to think that laboratories that were forced to let employees go would turn to outsourcing as a way to maintain production levels.

However, outsourcing has been an area where labs tended to cut back over the past year, with many companies attempting to perform more tasks in-house to save money (in some cases despite having reduced staff sizes). Survey participants showed less confidence in the coming year that investments will be made to outsource work when required to achieve their research and development objectives. The confident group dipped from 45 percent going into 2009 to 37 percent going into 2010, while the not-confident group increased from 22 percent to 39 percent. The group that didn't know decreased from 34 percent to 23 percent.

Survey participants were also asked to compare their expected levels of outsourcing in 2010 to prerecession levels of two to three years ago. Twenty-seven percent indicated that they expect that their organizations will outsource more than they did prior to the recession, while 40 percent expect the same level and 15 percent expect a decrease. Eighteen percent indicated that they have not outsourced in the past two to three years.

Technology investments

Although many companies reduced their investments in technology in the past year, many lab managers consider this to be a crucial area in advancing their research and keeping their laboratories modern and relevant. However, technology is expensive, and though it is widely considered a necessary expense, many are still not confident that funding resources will be available for investment and for now are going to have to make do with the older equipment they already have.

Our survey participants were split fairly evenly as to whether they think that sufficient funds will be available to acquire the technology such as equipment, systems and instruments necessary to achieve their research and development objectives. The confident group was 43 percent (up from 35 percent last year), while the not-confident group was 45 percent (up from 31 percent last year). The group that didn't know decreased from 35 percent to 13 percent.

"You can't become immobilized by fear. You have to work through it."

Serguei Stremilov says that his lab at SVS Technologies & Research in Concord, Ontario, has no choice but to continue investing in technology.

"We are growing from an embryonic state, so therefore we can't just stop and wait," he says. "We will grow or, less likely, just disappear."

Mueller says that Cortex did not invest in technology over the past year, but that the company had been actively doing so before the downturn of the economy.

"You always have to update things you're doing, so yes, we did invest in technology," he says. "But we just stopped it in order to preserve money. Now it completely depends on whether we can get more funds or not. If we can, I think we will invest, but if we don't have the money, we won't."

Construction and renovation

Like technology, another major cutback that laboratories have made since the economic downturn was to curb construction and modernization projects. When asked in late 2008 if their organizations anticipated any construction projects to start within the next 24 months, only 25 percent said they did and 53 percent said they definitely did not (22 percent indicated they would be investing in projects that were already under way). This year, however, these numbers have virtually reversed. When asked this year, 51 percent indicated that they anticipated construction to begin within 24 months and only 28 percent indicated that they were definitely not investing. *For attitudes toward "green" investments, go to www.labmanager.com/confidence/green*

Despite the challenges that the economy continues to present, the overriding theme in the scientific community seems to be that 2010 will be different from 2009, if not better. In order to survive, it will be necessary to take action and be aggressive. Sitting back and waiting for the economy to improve is a very dangerous approach. The survivors thus far have managed to summon the strength to fight through the worst economic environment since the Great Depression, and now there is a light visible at the end of the laboratory providing new hope and fresh determination to start pushing that lab cart back up the long steady incline.

"It's a scary world out there, but you can't become immobilized by fear," Mr. Suderman says. "You have to work through it."

Richard Daub is a freelance journalist based in New York City who writes for trade publications in a variety of different industries. He can be reached by phone at 917-657-6532 and by e-mail at rdaub82@gmail.com.

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COMMUNICATING A VISION

A CRUCIAL FIRST STEP IN BEGINNING A TRANSFORMATION WITHIN YOURSELF AND THE GROUP YOU LEAD by Kerri Harris

Today's business climate of outsourcing, in-sourcing, virtual teams, and ROI-driven objectives can leave a manager at any level feeling powerless. Yet we often see examples of those who can elicit unwavering support from their teams, driving highly effective projects, and getting the best performance from employees despite ever-increasing workloads. What is it about these individuals that makes them stand out as great leaders? Generally, the answer is the difference between a strict management model and one that includes basic principles of leadership. There are recognizable characteristics in great leaders and simple strategies anyone can adopt to improve employee performance and change the work environment for the better.

"Not all great performers translate into great managers."

Experts have long studied the subtle differences between general management, leadership, and truly great leaders. Thomas Cronin, author of *Thinking about Leadership,* observes:

"Managers do things the *right way,* while leaders are more concerned with doing the *right thing.*"

A focus on managing projects and deadlines leaves little room for leadership activities, but it can be done in a step-by-step approach beginning with awareness and a little common sense.

The remainder of this article addresses the following areas:

- *Personal evaluation*
- *Creating a shared vision*
- *The collaborative process*
- *Communicating the vision*

Personal evaluation

From the beginning, we are taught that outward signs of success are shown through upward promotions and ever-increasing responsibilities. But not all great performers translate into great managers. One has to consciously decide to take on a leadership role, adopting new tactics to lead others. This requires careful thought and consideration of one's own goals and a willingness to change. Begin with an honest inspection of your own situation by asking yourself the following questions:

- *How well do I understand the department's role in helping to meet the company's larger goals?*
- *Can I summarize the group's mission in one sentence?*
- *Can I articulate the kind of environment in which I want to work, and can I share that vision with my team?*
- *When necessary, am I willing to argue against my superiors to protect the integrity of our work, and will the organization allow such challenges?*
- *How well can I identify the strengths and weaknesses of those with whom I work, and can I channel those strengths and weaknesses into positive tasks?*
- *Am I willing to delegate assignments and provide the kind of information others need to complete these tasks well?*
- *Am I willing to make mistakes, accept others' mistakes, and use these as opportunities for improvement?*
- *Will the group's role still exist in two years, five years, and beyond?*
- *Am I willing to empower others to make decisions and foster creative thinking?*
- *Do I believe that I can make a difference, no matter how small?*

Objective answers to these questions do not always provide clear direction, but they do help determine a personal commitment to accepting a leadership role. Self-inspection drills like this one can lead to the realization that vast improvements are needed or even that an individual is in the wrong role or wrong organization altogether. It's a personal decision, but a critical review for any manager, newly promoted or a seasoned veteran, to undertake from time to time. It also lays the groundwork for the most important principle of management: communicating a vision.

"If you want to build a ship, then don't drum up men to gather wood, give orders, and divide the work. Rather, teach them to yearn for the far and endless sea." —Antoine de Saint-Exupery

Creating a shared vision

The first critical task of any leader is to effectively communicate the vision. A mission statement is the intrinsic "Why?" of your department's very existence, and the vision becomes the "How?"—a compass from which everything else is driven. The Alliance for Nonprofit Management, a professional association of nonprofit business managers, describes a vision statement in the following terms "…If a strategic plan is the 'blueprint' for an organization's work, then the vision is the 'artist's rendering' of the achievement of that plan. It is a description in words that conjures up a similar picture for each member of the group of the destination of the group's work together." This concept highlights the value of your contributions within the organization now and in the future. Every assignment and every objective stem from this vision and define the basic goals for everyone within your group to achieve that vision.

"Including your staff in a collaborative process cultivates buy-in and general acceptance."

Defining a vision is based largely on the expectations of your superiors within an organization, but there is always room to further define your vision within the scope of those expectations. For example, a department of technical writers may be perceived as necessary for document management and process control, but a mission statement that illustrates a best-in-class performance communicates significance—a statement that the group's employees may not really understand. Often, employees who do not feel valued or don't believe that their efforts matter have lower productivity and lower overall job satisfaction.

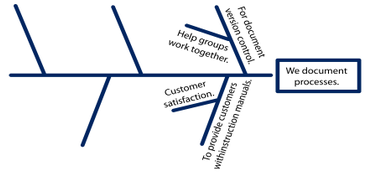
Establishing a carefully planned and documented vision with your direct reports defines goals for the group and creates a personal ownership for every individual. Including your staff in a collaborative process cultivates buy-in and general acceptance. While not all employees will enthusiastically support the end results, you'll have far greater success than if you attempt to impose your will and force others to adopt a new guideline.

The collaborative process

When beginning to discuss a vision with your team, first define the core values of your organization. These are the common ideals that everyone can understand, including integrity, creativity, innovation, service and accuracy. If challenged in a new business climate, the organization would retain these principles. Review with your team the core values and mission statements for the company and decide if your team's performance has adhered to that mission.

The next phase of building a vision includes an examination of what your team will aspire to become or to achieve as long-term goals. James C. Collins and Jerry I. Porras illustrate this technique in *Built to Last: Successful Habits of Visionary Companies.* They describe a simple process of inspection that will further define the vision for your team. Begin with a single sentence of what the department does, and then ask the group to explain why it is important. Ask this question five times. If your department ceased to exist tomorrow, what would the company lose? This discussion leads to the heart of your department's contributions to the organization as a whole.

▼ *Example of the "Five Whys" Discussion*



Collins and Porras illustrate this technique with examples of visions from identifiable companies that helped shape their mode of operation for years:

- *Become a $125 billion company by the year 2000. (Wal-Mart, 1990)*
- *Become the dominant player in commercial aircraft, and bring the world into the jet age. (Boeing, 1950)*
- *Become the company that most changes the worldwide image of Japanese products as being of poor quality. (Sony, early 1950s)*
- *Crush Adidas. (Nike, 1960s)*
- *Transform this division from a poorly respected internal products supplier to one of the most respected, exciting, and sought-after divisions in the company. (Components support division of a computer products company, 1989)*

Communicating the vision

After you have established a vision for your department, communicating it becomes an important final step. James O'Toole, author of "Leadership from A to Z," describes this communication in broad terms: "The task of leadership is to communicate clearly and repeatedly the organization's vision…all with the intent of helping every person involved understand what work needs to be done and why, and what part the individual plays in the overall effort."

Communicate the vision often, in both subtle and dramatic ways. Tie the day's events back to the vision, underscoring its relevance. From internal memos, presentations or posters, the vision serves as a reminder to the team of its purpose and goals. The vision can be incorporated into objective-setting and performance-review standards as well as into interdepartmental projects. These steps serve to energize and direct the group's actions as stakeholders and advertise your efforts to upper management.

Developing leadership qualities as a manager not only improves the group's performance but also equips managers to deal with the demands of business performance. Managers today do not have the luxury of time for in-depth strategy sessions, team-building excursions, and one-on-one personal reviews, thanks to an increased virtual work force. Teams are spread across the globe, operating at different hours, across cultures, all while working against critical deadlines and lofty objectives. Yet taking the time to initiate a small goal like creating a vision is the first step toward creating a better team, a stronger workforce, and entrepreneurial thinkers. This crucial step initiates the beginning of a transformation within yourself and a larger effect on the group you lead.

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REFEREEING RESEARCH PAPERS

ALLOWING YOUR STAFF TO PARTICIPATE IN THE PEER-REVIEW PROCESS DELIVERS A HOST OF BENEFITS by John K. Borchardt, Ph.D.

Reading and using the results of research papers provides the lifeblood of industrial research: innovation. At the same time, peer review requires that researchers who are experts in the same field evaluate these manuscripts prior to publication to suggest improvements, require additional work to prove assertions if necessary, and identify errors. Reputable research and trade journals publish papers only after the author has responded to reviews and made required changes. Peer review plays a critical, some would say essential, role in improving the quality of published research papers. Sense About Science—a charitable trust to promote good science and evidence for the public—sponsored the Peer Review Survey 2009, which is available at www.senseaboutscience.org.uk/index.php/site/project/395. In the survey, 91 percent of participants said that peer review improved the quality of their last published paper.

"Peer review plays a critical, some would say essential, role in improving the quality of published research papers."

A second survey, by the Publishing Research Consortium (PRC), found that 69 percent of the respondents enjoyed being able to improve the quality of a paper, while 75 percent enjoyed seeing new research prior to publication. The PRC is a group representing publishers and professional societies supporting research on scholarly publication; their survey is available at www.publishingresearch.net/documents/PeerReviewFullPRCReport-final.pdf.

Your research staff can play a role in the peer process by participating as referees for manuscripts. What are the advantages and disadvantages of doing so? Should you encourage your research staff to participate in reviewing manuscripts?

Positive factors

Conducting a thorough manuscript review takes time. However, doing so can improve your staff's morale by allowing them to participate in basic research. PRC survey results indicate that 90 percent of the survey respondents said that they act as manuscript referees because they believe that it enables them to play an active role in the scientific community. Your own lab's projects may benefit from your staff members receiving an advance look at research results that may be relevant to their own work. In addition, 86 percent of survey respondents reported that they enjoy the process of conducting manuscript peer reviews.

One problem noted by survey respondents is that new manuscripts often don't cite relevant previous work. Eighty-one percent think that peer review should ensure that previous research is acknowledged; however, only 54 percent think that it currently does. Your staff members experienced in a particular field can make a valuable contribution by drawing authors' attention to previously published work described but not cited in a manuscript.

Reviewing also helps your laboratory staff develop professional networks outside your company by acquainting them with researchers in fields related to their own work. Peer review can be particularly helpful in learning the names and affiliations of little-known but up-and-coming researchers in fields relevant to your laboratory's work. Research discussions and visits may even lead to having your laboratory fund some of the work of these rising stars.

Reviewers are anonymous. Among the survey respondents, 58 percent said they would be less likely to review manuscripts if their signature on a report were published. Seventy-six percent favor having only the editor know who the reviewers are. Of course your staff members can contact research paper authors without revealing that they reviewed the authors' manuscripts.

By reviewing research papers, your staff member gets

an advance look at the work of coauthors, graduate students or postdoctoral researchers who may be valuable additions to your staff.

Some industries, such as those in the petroleum, chemical, paper and corrosion fields, boast excellent trade journals that publish peer-reviewed papers. Being a manuscript reviewer for such a trade journal can result in your staff member receiving an invitation to write a review in the same technology area. Such a review can add to the reputation of your laboratory and result in new business for your firm.

"Your staff member gets an advance look at the work of ... researchers who may be valuable additions to your staff."

Potential negative factors

One issue associated with peer review is the time required to review a manuscript. However, according to the Peer Review Survey, technology has made reviewing easier now than it was only five years ago.

Lack of guidance on how to review manuscripts may be a concern among your staff members, making them reluctant to conduct peer reviews. More than half of respondents to the Sense About Science survey, 56 percent, said that there is a lack of guidance on how to review. Just over two-thirds, 68 percent, said that formal training would help. Such training is becoming more available. For example, in November 2009 there was a workshop on reviewing manuscripts held at the American Chemical Society's Southwest Regional Meeting. One possibility is to bring an experienced research manuscript reviewer to your facility to conduct such a workshop. Inviting young science faculty members from nearby universities and colleges to also attend could redound to the credit of your laboratory.

Detecting plagiarism and fraud when reviewing manuscripts is a noble aim but is not generally practical due to the time and extensive work required.

Final thoughts

Reviewing research manuscripts can be a rewarding activity for your staff members if done in moderation. Since most researchers enjoy acting as reviewers, laboratory managers may have to assume one more responsibility: monitoring to ensure that staff members do not become overenthusiastic participants in the peer review process. One way to maintain the needed control is to require that staff members obtain their supervisor's permission to referee a manuscript, while making it clear that you support a moderate amount of manuscript review.

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

LEADERSHIP & STAFFING

ABOUT THE SURVEYS

By John K. Borchardt

Sense About Science is a UK-registered charity that aims to help people understand science and evidence. It has previously published reports on peer review as well as the open access guide to peer review, "I Don't Know What to Believe" (www.senseaboutscience.org.uk/index.php/site/project/395). In 2008 it established its online education resource about scientific publishing and peer review.

The Peer Review Survey 2009 was an electronic survey conducted July 28 – August 11, 2009. The 40,000 researchers surveyed were randomly selected from the International Science Institute (ISI) author database listing published researchers from over 10,000 journals. (The ISI website is wokinfo.com/.) The response rate was just over 10 percent. The error margin was ± 1.5 percent at a confidence level of 95 percent confidence. The 3,597 reviewers answered a series of questions aimed specifically at them. The error margin for this smaller group was ± 1.6 percent at a confidence level of 95 percent.

The full findings and report are available at www.senseaboutscience.org.uk/index.php/site/project/29/.

SHARING THE WORKLOAD

CHROMATOGRAPHY LAB EMPLOYS SIX SIGMA STATISTICAL TOOLS TO EFFECTIVELY CROSS-TRAIN SPECTROSCOPY ANALYSTS TO HANDLE CHROMATOGRAPHY. **By Vishnupriya Bhakthavatsalam, Ph.D.**

Efficient use of resources for workload management in analytical laboratories is the need of the hour. Irrespective of their size, laboratories are working to reduce their operational costs and shorten turnaround times to the delight of their customers. In the current economic situation, it is harder to have a dedicated analyst for a single instrument. We have a system of sharing the workload in our laboratory; for example, an analyst whose primary responsibility is HPLC has secondary responsibility for FT-IR and GC and is cross-trained in those. This way, when demand is low for HPLC, he can work on other instruments. This helps in efficient utilization of equipment resources as well.

"Cross-training...ensure[s] that the laboratory's workload can be carried out without any hiccups."

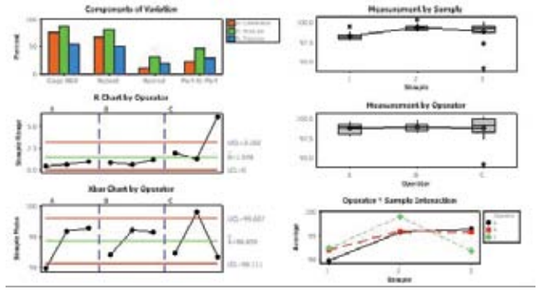
Cross-training the analyst is essential in order to ensure that the laboratory's workload can be carried out without any hiccups and to enable the samples to move more smoothly through our workflow. It also gives an analyst the chance to use characterization techniques that could be complementary to those he or she has experience with. Cross-training is also advantageous to the laboratory in the sense that the primary analyst can go on a vacation without worrying about the pending samples on his desk when he returns. However, the laboratory manager still has to ensure the quality of the data delivered.

The main concerns with respect to measurement variation are an analyst's bias, training and instrument experience. Our chromatographic laboratory quality team decided to use Six Sigma statistical tools for measuring variation between analysts to effectively cross-train spectroscopy analysts to handle chromatography. An exhaustive analysis of errors was derived from gage repeatability and reproducibility ("Gage R&R") studies. The studies gave us an estimate of the precision to tolerance (P/T) ratio of the measurement.

Data from three analysts was used for the Gage R&R study. Analysts A and B were experienced, and analyst C was to be cross-trained in HPLC. Our customer requirements demanded that analyst-to-analyst variation be minimized. In this particular study, scope was restricted to measurement of errors arising from instrument operation and the analyst taking the measurements.

The training sets were taken from fiber additive samples in representative percentage concentrations. An initial set of results was obtained, using existing methods and conditions, with three samples of the additive prepared by experienced analyst B. Each analyst ran three samples of six injections each for a total of 18 runs, resulting in a total of 54 runs for each trial. So far, two sets of trials have been completed, which are mentioned as two phases in this article, and a Gage R&R study was conducted.

Initial results for the first phase are shown in Figure 1. Total variation is expressed as a percentage and consists of equipment variation, analyst variation, part-to-part variation and Gage R&R. Repeatability is the variation in measurements obtained with one gage in the same measuring environment when used several times by one analyst while measuring the identical characteristic on the same part. It is also commonly known as equipment variation. Reproducibility is the variation in the average of measurements made by **different** analysts using the same gage when measuring the identical characteristic on the same part. It is commonly known as appraiser variation.



▲ *Figure 1. Initial Gage R&R (ANOVA) studies (first phase) generated after injecting additive sample 18 times in HPLC by each analyst.*

Initial Gage studies showed repeatability to be 82 percent, reproducibility among the analysts to be 31 percent and total gage to be a whopping 88 percent. The acceptable range for all three values should be <30 per-

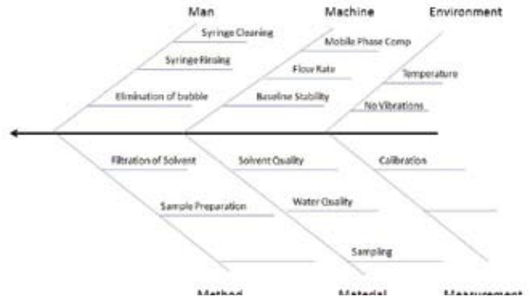
cent. These values for repeatability and reproducibility showed that total variation was due to the equipment/method and, to some extent, the analyst (analyst C needs to be trained according to the SOP). Also, part-to-part variation was found to be 47 percent; ideally, part variation should be high to represent the full variation of the process. A rule of thumb is that total Gage R&R should be <10 percent to be acceptable; however, 10–30 percent may be acceptable based upon the risk of the application, cost of measurement device, cost of repair, etc.

The effective resolution of the measurement system can be determined by its ability to distinguish data within several data classifications or distinct categories from the observed process for a given application. The number of distinct categories in this initial phase of the Gage R&R study was found to be one, but it needs to be at least four or more for it to be a good gage. In Minitab 15 (a software application used for conducting Six Sigma studies), 6.00 is the default for the study variation for a Gage R&R study. This is the Z value range that calculates a 99.73 percent potential study variation based on the calculated standard deviation of the variation seen in the parts chosen for the study.

In Gage R&R, the R-chart is a special range chart that tells us whether the measurement is within the statistical control and usually gives us an idea about repeatability. Here, operator/analyst C has an outlier, and this could be attributed to insufficient operator training. Operator/analyst B is within acceptable range due to his experience with the instrument/method. The same information is also obtained from the box plot on the right, where measurements by operator are represented. The measurement variation of the second analyst is less in comparison with the third analyst. The X-bar chart by analyst gives the reproducibility portion of the Gage R&R. It helps us with the removal of special-cause variation. In the X-bar chart, only two points fall outside the limits, and so the measurement process is not adequate to detect part-to-part variations; hence, the gage is not good.

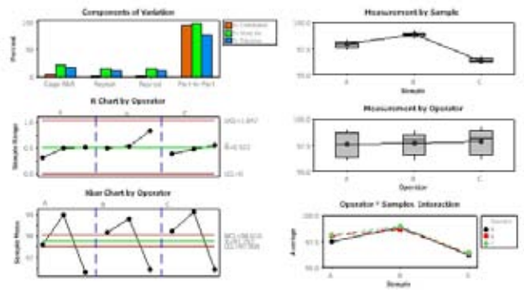
Operator-sample interaction in the Gage R&R study also helps us understand reproducibility among the operators. Compared with the other operators, analyst C has some interaction with the samples. Analyst C is biased positively with the measurements and measures the samples higher than the other analysts, as seen from the operator-sample interactions.

Figure 2 shows a cause-and-effect diagram, otherwise known as a "fishbone" diagram, which allowed the HPLC quality team to systematically identify and display all the possible causes related to the bottlenecks in the quality of the data and turnaround time of the HPLC tests. The four main categories identified were machinery/equipment, people, methods and materials. Primary causes were shown to be the operator, method and environment. The detailed SOP included protocols for syringe cleaning and bubble elimination to improve reproducibility. Noise elimination due to the change in temperature was also addressed to reduce measurement variation.



▲ *Figure 2. "Fishbone" diagram with the four main categories identified included for tests in HPLC; machinery/equipment, people, methods and materials.*

After the training of analyst C was completed, the data from the second-phase Gage R&R studies showed tremendous improvement compared to the first-phase data. Figure 3 shows Gage studies conducted for the second trial. Higher part-to-part variation (97 percent) was an indication that the samples are representative of full variation of the process. Improvement in precision was observed, as repeatability of the gage was found to be 15 percent. Exhaustive training imparted to analysts also had improved the reproducibility to 15 percent. Total Gage R&R was 22 percent, which is within the acceptable range. The number of distinct categories was found to be six, showing that this was a good gage. Overall, our gage was found to be good, with high part-to-part variation and acceptable repeatability and reproducibility. Improvement in gage can primarily be attributed to training of the operators using the detailed SOP created after the fishbone diagram was developed.



▲ *Figure 3. Second phase Gage R&R (ANOVA) studies generated after injecting additive sample 18 times in HPLC by each analyst after training in detailed SOP.*

When we interpret the R-chart from the Gage R&R data, all the points are within limits (Upper Control Limit (UCL) and Lower Control Limit (LCL)), and so the measurement process is under control and is said to be consistent. In the X-bar chart, more than 50 percent of the points lie outside the UCL and LCL, hence the gage is good. Our analysts showed considerable improvement at the end of the study, as inferred from operator-sample interaction in the Gage R&R study. Very low operator-to-sample interaction confirms that analyst C is not biased while making the measurements as compared to first-phase measurements. This shows that analyst C has been trained well using the detailed SOP prepared after incorporating the syringe cleaning procedure and noise reduction precautions. Analyst C's discussions with his manager and with experienced analyst B helped him achieve the cross-training required to maintain the quality of the data.

Acknowledgements

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TECHNOLOGY & OPERATIONS

IMPROVING SAMPLE THROUGHPUT

RAPID SAMPLING SYSTEM COUPLED WITH ICP-MS REDUCES ANALYSIS TIME OF TYPICAL CLP SAMPLE BY 80 PERCENT

By Kenneth Grzybowski

CompuChem, a division of Liberty Analytical based in Cary, North Carolina, analyzes samples under the Superfund Analytical Services Contract Laboratory Program (CLP). In the 27 years CompuChem has been involved with the program, we have probably analyzed more CLP-type samples than any other lab in the U.S.

The company recently improved sample delivery, measurement protocol, and rinse-out times by coupling an SC-FAST autosampler from Elemental Scientific with a PerkinElmer SCIEX™ ELAN® DRC-e inductively coupled plasma mass spectrometer (ICP-MS). We have reduced the time required to analyze a typical CLP sample by 80 percent.

"Most labs use ICP-MS for analyzing samples with very low analyte levels and are not overly concerned about sample throughput."

ICP-MS offers detection limits that, on average, are 1/1000 of those provided by inductively coupled plasma optical emission spectrometry (ICP-OES) and about 1/10 to 1/100 of graphite furnace atomic absorption (AA) spectroscopy. As a result, most labs use ICP-MS for analyzing samples with very low analyte levels and are not overly concerned about sample throughput. A typical ICP-MS user would likely be satisfied with a 10-minute-per-sample analysis time for the determination of 22 elements in triplicate. In fact, many analysts would probably accept much longer analysis times, especially if they had previously been forced to use two or three techniques to determine all 22 elements.

However, environmental laboratories carrying out high-volume CLP-type analysis have much more demanding throughput requirements. The major reason for this kind of productivity demand is the EPA's need for a vast amount of data in support of the investigation and cleanup of contaminated hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The methodology that describes the determination of inorganic contaminants in these kinds of samples is outlined in the IlM05.3 (2004) and the updated IlM05.4 (2007) Statement of Work (SOW), which defines the analytical methods accepted by the CLP for the quantitation of 24 inorganic analytes, including mercury and cyanide, in water, soil, and sediment samples using ICP-OES, ICP-MS, cold vapor (CV) AA, and colorimetric techniques.

The Superfund CLP program can generate extremely large numbers of samples because the data is critical for determining the extent of contamination at hazardous waste sites, assessing the response based on risks to human health and the environment, deciding on appropriate cleanup actions, and making determinations as to when remedial actions are complete. In addition, the data may also be used in litigation against responsible parties in the enforcement of Superfund legislation, which means the contract lab that carries out these analyses may be required to testify in court as to the integrity of its results. The bottom line is that the amount of data generated under this contract is exhaustive and must be of the highest quality because it is used to make major decisions regarding public health and environmental safety issues.

CompuChem has been carrying out continuous and uninterrupted contract work with the EPA since the CLP was initiated in 1981. Back in September 2008, the company's existing 10-year-old ICP-MS had a catastrophic failure and was unable to run any samples until it was fixed or replaced. After a cost-benefit analysis, it was determined that repairing the instrument was not an option. CompuChem contacted all the major vendors and chose an ELAN® DRC-e. All the vendors were telling us it would take eight to ten weeks to get an instrument, which was unacceptable and would have cost us numerous contracts and revenue. PerkinElmer, after initially quoting us eight weeks, was able to readjust their time frame and have the instrument delivered to us in three weeks.

Ron Buchanan, senior ICP-MS service engineer for PerkinElmer, installed the DRC-e instrument and provided the company with basic training, all in a few days. Even though we were not familiar with the software, after the instrument was installed, it took us only one week for training and method development before we were running samples again. We were very impressed that we could get back online so quickly.

▲ *By coupling the PerkinElmer SCIEX™ ELAN® DRC-e (shown here) with an SC-FAST autosampler, CompuChem has significantly increased its sample throughput.*

Since then, CompuChem has coupled an SC-FAST autosampler to its ICP-MS and by optimizing sample delivery, measurement protocol and rinse-out times, the lab is now analyzing a CLP sample for 30 elements in triplicate in one minute and 30 seconds. We had no idea that we could have increased our sample throughput by this much. The same analysis on our previous instrument took us nine minutes and 53 seconds, which translates into more than a fivefold improvement in sample throughput. There is no doubt in my mind that the ELAN® DRC-e will be critical to our mission.

SC-FAST is a rapid-sampling approach that significantly reduces the pre- and post-measurement times involved with delivering a new sample to and removing the previous sample from the ICP-MS. The autosampler probe is moved to the next sample while the previous sample is being analyzed, saving considerable time. A small vacuum pump rapidly fills the sample loop, which is positioned in proximity to the nebulizer, minimizing sample uptake time. Little or no signal stabilization is required, because the pump delivering the sample to the plasma remains at a constant flow rate and the injection valve ensures that no air is introduced into the sample line.

Improved productivity, combined with the recognized interference reduction capabilities of the ELAN DRC technology for the more difficult environmental analytes like selenium and arsenic, is helping the lab achieve its goal. The instrument is able to keep up with the current demands of the EPA Contract Laboratory Program and other environmental test methods and is also capable of testing based on future EPA trace element regulations as they inevitably will require detection of lower levels.

Kenneth Grzybowski, *laboratory manager CompuChem, can be reached via email at kgrzybowski@compuchemlabs.com.*

WANT YOUR WORKFORCE TO THRIVE? INNOVATE!

As scientists around the globe research cures and treatments for diseases, work to increase the data capacities of the information superhighway, and develop methods to clean the environment, they must also take time to contemplate the future of their industry, especially after the economic downturn of 2009.

"Employees of all ages and past work experiences can benefit from mentoring programs."

Scientists of all skill levels and past work experiences will likely consider some of the following questions during the coming year:

- *How should I prepare for the future?*
- *How can my organization obtain long-term success?*
- *How can I not only survive, but thrive, in the current economy?*

In order to succeed throughout the coming months and years, scientists must *innovate*. The following four innovation methods have helped Kelly Scientific Resources, a specialty service of Kelly Services, Inc., not only succeed in spite of the global economic challenges, but become an industry leader in staffing solutions. By implementing each of these innovative methods within their organizations, scientific managers and employees will be well-prepared for success throughout the upcoming year and well into the future.

Develop a mentoring program within your organization

As new employees continue to join your organization, a proper onboarding process will ensure that they are comfortable with their roles and welcomed within your organization. Employees of all ages and past work experiences can benefit from mentoring programs.

First, new employees will learn about their positions quickly and efficiently through adequate support from a well-experienced mentor and fellow employee. Through quality on-the-job training, new employees will not only make fewer mistakes as they adjust to their new roles, they also will be able to showcase their talents and skills while working to remedy their weaknesses.

Second, as mentors connect with recently hired employees, they are able to develop a sense of community. History has shown that as connections develop between employees, organizational teamwork typically improves and employee trust increases. In addition, mentoring can create loyalty within an organization, as employees help each other complete projects and learn to trust one another while they complete assignments as a team unit.

"As connections develop between employees, organizational teamwork typically improves."

Provide online training

Many scientific organizations provide technological applications for their employees while they improve their skills on the job and in training situations away from the office. Through training programs, scientists can improve their leadership, products, and soft skills as they learn about the history of their organizations and the ways they can help their companies achieve success.

Employees can also receive certification through a variety of online courses that will strengthen their current skill sets and give them new skills to apply throughout their careers. Online certification will likely continue to grow in popularity within the scientific industry, as it proves its positive impact on inexperienced and veteran employees.

Create employee recognition programs

As employees continue to improve their skill sets and work performance, many are rewarded for their hard work and dedication. Through employee reward and recognition programs, highly talented scientists receive public appreciation for their service. Rewards and recognition boost employee morale and show employees how valuable they are to their company.

In recent years, Kelly Scientific Resources has recognized employees both for outstanding performance and long-term, dedicated service. Through anniversary awards, extra time off, and gift cards, Kelly's top talent continuously feel appreciated for all they do for the organization.

Your employees can also feel respected and appreciated through successful reward and recognition programs. As scientists strive to enhance their skill sets, serve their fellow human beings, and improve peoples' lives, they deserve rewards and recognition throughout the entire year.

"Scientific organizations should improve their community outreach capabilities."

Reach out to your community

Finally, scientific organizations should improve their community outreach capabilities. By developing relationships with other organizations, updating the general public on current organizational events, and creating newsletters, scientific organizations can win support from a variety of organizations and people, even outside the scientific community.

Many scientific organizations provide the general public with information about their main events and key accomplishments through press releases and newsletters. These types of media enable the organizations to reach out to their communities, as well as inform current employees, prospective employees, and other people about the ways in which they positively impact the world on a daily basis.

Through a variety of innovations ranging from the development of mentoring programs to community outreach, scientific organizations should continue to thrive during the coming years, serving people and improving their lives well into the future.

Are you prepared to build a sustainable competitive advantage for your company's future? Let's begin by harnessing your talent through innovative workforce approaches.

***Rich Pennock** is vice president of Kelly Services, Inc., a world leader in workforce management services and human resources solutions. For more information, visit www.kellyservices.com. Rich can also be followed on Twitter at twitter.com/richpennock.*

LAB SAFETY

SEPARATION ANXIETY

AVOIDING CHEMICAL INCOMPATIBILITY ISSUES

By Vince McLeod

Here is a statistic that jumped out at me recently: improper storage of chemicals accounts for nearly 25 percent of all chemical accidents.[1] Why is that? This is a sad statistic, given that all these accidents are entirely preventable, yet they continue to happen despite the availability of numerous and excellent resources just a few keystrokes away.

Here is a typical incident:

The collapse of a shelf in a flammable liquid storage cabinet led to an explosion and a fire in a lab at company X, causing the destruction of two labs and damage ranging from $200,000 to $300,000 in repairs. Spills due to the unstable shelf had occurred previously, but no one had tried to repair or replace the defective shelf. In this instance, 12 containers of hexane were being unpacked into a flammable liquid storage cabinet when one of the shelves collapsed. The resulting three-alarm blaze took about 20 fire trucks and 84 firefighters from several area fire stations more than an hour to extinguish.[2]

And another one, but at least with a positive aspect:

Flammable Liquid Storage Cabinet Prevents Ignition of Flammable Solvents

A laboratory fire started in a refrigerator used for storing experimental samples—small quantities of solvents and other chemicals. It is thought that an electrical fault may have been the cause. Apparently, the fire burned for some time, igniting the plastic refrigerator lining before burning through the door seal and spreading into the room.

The refrigerator was adjacent to the storage cabinet pictured above, which contained a large quantity of flammable solvents. The photo shows the cabinet after the fire. The scorch on the right side of the cabinet was caused by the burning frig (the seat of the fire). The mark at the top of the door was caused by burning material (a plastic light fitting) that dripped onto the cabinet and continued to burn.

Although burning material had dripped into the lap seal above the door, there was no sign of any flame within the cabinet, and the interior paint finish is in original glossy condition. Although the soot was drawn into the cabinet by the ventilation fan, antiflash vents prevented flames from entering the cabinet.[2]

These two incidents demonstrate common errors in storing chemicals, the first being a defective, overloaded or incorrectly installed shelf, and the second being improper storage of solvents in a standard refrigerator. They also exhibit another common mistake that is the topic of this month's Safety Guys article—a lack of proper segregation or separation of incompatible materials.

"When we are dealing with solids and liquids, physical separation becomes a judgment call."

Important determining factors

Most of us would consider good chemical storage in the lab as having a hood with two cabinets below, one for corrosives and the other for solvents, and everything else being placed on shelves throughout the lab or out on the workbenches. If we are lucky, there may be a flammable storage cabinet and possibly a refrigerator for samples and small containers.

But safely storing hazardous chemicals is much more complex than that (as we have just read) and depends on a lot of factors. Perhaps the most obvious is the nature of chemical operations or the research focus of the laboratory. A large, busy organic synthesis research lab is a lot different than a dedicated inorganic water quality lab both in terms of types and quantities of chemicals in use and storage. The next most important factor for the lab manager is the level of employee expertise. We must always keep this in mind and ensure that our people are well-trained. Finally, there are the always-present local and state regulations and building and fire codes.

Determining proper segregation for laboratory chemicals

Not discounting the importance of the wide variety of requirements and limitations mentioned above, we are going to focus here on incompatible chemical storage and proper segregation of these materials. What does "incompatible" mean anyway?

LAB SAFETY

When certain chemicals are mixed or come into contact with each other, chemical reactions occur. The uncontrolled mixing or contact usually happens in circumstances such as spills, leaking containers or partially open containers, and it results in reactions that produce hazards. The hazards include heat or pressure, fire or explosion, violent reactions, toxic or flammable mists, and fumes or gases. Chemicals that react to produce these hazards when mixed together are termed "incompatible." To prevent uncontrolled hazard production, we need to segregate incompatible materials and store them separately from each other.

How do we know we have adequate separation? Separation is accomplished by distance, partitions, cabinets and containment devices. In reality there are very few strict written guidelines. One example involves compressed gas storage and the applicable fire codes that mandate 20 feet or more of separation between oxygen and flammable gases.[3] This is a large distance, necessitated by the physical properties of gases, such as their expansion and dispersion. When we are dealing with solids and liquids, physical separation becomes a judgment call and depends on the quantities stored and the type of storage used. We prefer physical barriers or separate cabinets for incompatible groups, when possible. Containment devices are acceptable and work well if space is limited. These can be as simple as plastic tubs to keep acids and bases separated in a shared cabinet. Just make sure that the device is big enough to hold the entire volume of the largest container being stored.

Determining chemical compatibility

The surest way to determine incompatibility is to check the Material Safety Data Sheet (MSDS) for each chemical. The MSDS will give the chemical family for the material and list incompatible substances in the reactivity data section. However, checking each one could prove tedious, especially if a lot of different chemicals are used in the lab. So, we usually refer to chemical compatibility matrices or lists that separate chemicals based on generic hazard groups. For example, groups that are used most frequently include the following:

- Flammable/combustible liquids (and organic acids)
- Flammable solids
- Mineral acids
- Caustics (bases)
- Oxidizers
- Perchloric acid
- Compressed gases

Many of these compatibility charts and lists have been published (a few are given in the resources below), and we recommend that you find one that suits your needs and keep it posted in the lab in a conspicuous location so that lab personnel can easily refer to it when storing chemicals. With your favorite compatibility reference and the lab's chemical inventory, you can quickly determine how many different groups (and thus, storage spaces) are needed and begin to segregate your chemicals.

A few last words

Some words of caution are in order. No matter how complete your list seems or how complex the compatibility matrix appears, there is always the exception chemical, the one that falls into two (or more) groups. Beware of this and seek expert advice when you are unsure about safe storage. In closing, here are a few more guidelines for safe chemical segregation:

- **Do not** store chemicals alphabetically as a general group. Separate into compatible groups first.
- **Do not** store chemicals on high shelves or in high cabinets. A good rule is to store them at eye level or below.
- **Do not** store chemicals on bench tops or in hoods, except for those being used currently.
- **Do not** store incompatible materials one above the other on shelving in the lab. Prevent any chance of accidental mixing.
- **Do** separate chemicals into their organic and inorganic families and then compatible groups.
- **Do** provide a definite storage place for each chemical and return the chemical to that location after each use.
- **Do** store volatile toxics and odiferous chemicals in a ventilated cabinet.
- **Do** store flammable liquids in approved flammable storage cabinets or safety cans.
- **Do** ensure that shelving materials are appropriate and compatible with the chemicals stored on them (e.g., do not store oxidizers on wooden shelves).

Finally, for those of us in seismically active regions, there are additional precautions (and probably regulations) to address. In these areas we should have lipped shelving and secured storage units, at a minimum. Check with your local authorities for additional guidance. As always, safety first.

Comments or questions are always welcome. Contact thesafetyguys@labx.com.

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3. *NFPA 55 Compressed Gases and Cryogenic Fluids Code,* 2010 edition. National Fire Protection Association, Quincy, MA. 2004. www.nfpa.org/AboutTheCodes/AboutTheCodes.asp?DocNum=55.

Additional Resources

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. National Research Council. National Academy Press. Washington, D.C. Latest edition.

NIOSH Pocket Guide to Chemical Hazards. National Institute of Occupational Safety and Health. Publication 2005-149. www.cdc.gov/niosh/npg/.

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EXPERT: Dr. Hakim Djaballah

Dr. Djaballah came to MSKCC in June 2003, and it took him nearly a year to get things up and running. The HTS laboratory became fully functional in August 2004. Today the Center's chemical library consists of nearly 380,000 compounds, and its proprietary small interfering RNA libraries consist of nearly 21,000 duplexes covering 6,000 genes. The collection also includes libraries licensed from other commercial sources. The facility has now developed and validated nearly 56 assays, and these screens have led to the identification of several "hits," initiated exploratory chemistry around several scaffolds, and led to patent filings and progression of compounds into the clinic. One of the screens contributed to FDA approval of the repositioning of a known drug for the treatment of retinoblastoma.

ASK THE EXPERT

SETTING UP A HIGH-THROUGHPUT SCREENING LABORATORY

by Tanuja Koppal, Ph.D.

Dr. Hakim Djaballah, Director of the High-Throughput Screening (HTS) Core Facility at the Memorial Sloan-Kettering Cancer Center (MSKCC) in New York City, talks to Tanuja Koppal, contributing editor to Lab Manager Magazine, about his experiences setting up a screening lab in an academic environment. After spending many months designing and setting up his lab, Djaballah is now finding it gratifying to see his screens yield new drug candidates that have moved to the clinic.

Can you provide some details on how you went about setting up the HTS lab at MSKCC?

It really boiled down to how much capital investment MSKCC was willing to make, and we had to make some very tough decisions to build a facility that could support the ongoing research in a very diversified fashion. I put a budget together based on the previous two labs that I had helped set up in biotechnology companies. My strategy was to make the screening facility very versatile to support both chemical and RNAi screens. The initial budget, drafted before I got here, was modeled based on what was happening in other academic labs, but it was later decided that the screening lab at MSKCC would be set up along the lines of the labs seen in industry. So I went about creating a business plan that included a mission statement and a return on investment of 10 years. MSKCC was happy to make the initial capital investment, which is very rare, and we did not have to depend on getting any grants funded. The versatility of the assays, the size and diversity of the chemical libraries, and the creation of databases and customized informatics solutions were all key aspects that contributed to the business plan. You really need a sound business plan from the get-go.

Are there any resources that can help lab managers draft budgets?

Unfortunately there are no resources or benchmarks to help lab managers put together budgets. There have been some publications on how much it would cost to screen a well but nothing around what it would take to build a screening facility. One of the reasons is that how much you spend is often a very sensitive issue and has to remain confidential.

How did you know what you needed from the get-go?

I made some assumptions, and one was that the assays run would be 50 percent *in vitro* and 50 percent cell-based, although there was more emphasis on *in vitro* in those days. When we went live in August 2004, the assays turned out to be 70 percent *in vitro* and 30 percent cell-based, but today it is 99 percent cell-based and only 1 percent *in vitro*. That's the danger in making assumptions: sometimes if you are wrong, you could be stuck with a completely different setup than what you need. I took a gamble on high-content screening, and that has now proved to be a workhorse for us. However, pushing siRNA screens in the early days was a disaster since we were led to believe that there were not many off-target effects, and that got us off to a wrong start.

Did you opt for customized solutions or did you go with the plug-and-play systems?

Mostly we opted for customized solutions. There were a lot of negotiations with the vendors. The robotic platform we currently have is the largest the vendor (Thermo Fisher Scientific, Inc.) had ever built. Having things customized was more expensive, but it provided us with the flexibility to do many things. If you go along with what is available, it will work but you will end up doing things differently from what you had set out to do. Especially on the informatics side, if the data output is not mirrored to the database you will have problems loading the data.

What other services do you offer besides the actual screening?

We provide consultation, which means a lot of people come to us early on with their ideas for screening and we spend time to guide them to get the best reagents and set up the best assay possible. We train high school and medical students for a few weeks each year to give them a feel for how drugs are discovered and how HTS plays an important role in that process. We also train graduate students and postdoctoral fellows on a regular basis.

How do you go about hiring people, and what type of training do they receive?

Recruiting the right people is very important, and this decision can sometimes make or break a screening facility, especially in academia. In academia, you almost never get people who are already trained, due to the salary discrepancies between academia and industry. So I often recruit people as research technicians or senior scientists and train them for six to nine months. Every year I also take in two or three postdocs who are very interested in going to industry but first want to join a lab like ours to see if they really like doing screening.

Right now I have 14 people in the lab, but only five or six of them are fully trained, and the rest, who are mostly new recruits, are being trained. This is not an ideal situation, but it is a consequence of our recent expansion into RNAi screening. When you are starting a new lab, you should start out with no more than two people, or else managing everything can be disastrous. It's important to first get them trained and then recruit more people. My personnel get a combination of internal and external training. I meet with them regularly to go through their progress with the use of certain technologies. They also receive training from vendors on site.

Currently are you experiencing any bottlenecks in your screening?

One of our bottlenecks is the incubator space to hold materials for cell-based assays. We can buy more incubators, but integrating them onto the robots will be a challenge.

We will either have to take things off the robot or we will have to expand the robots to accommodate the additional incubators. And this will have to be done by keeping the downtime to a minimum, probably no more than four weeks, which is difficult.

Could you have avoided this?

This probably happened because our initial goal was to run more chemical screens, and now with the addition of cell-based RNAi screens, the incubator capacities have nearly doubled. It's a tough situation, because if you buy more than what you need initially, it's going to hurt the capital investment. But if I were to make an assumption today, I would probably go with 80 percent cell-based assays and not 50 percent.

THE FOUR PILLARS OF HTS

- LIBRARIES
- INFORMATICS
- AUTOMATION
- BIOLOGY

What aspect of setting up the lab was the most challenging?

Setting up the informatics was the most challenging aspect, since everything was custom-built. We had to work with a number of contractors, which was stressful and very time-consuming. In fact, we completed the screen before the software programs were ready. In pharma it was different because the investments were larger, we could hire a large informatics firm, and payments were made by milestones. On the other hand, the part that was most stimulating was putting together my team and performing my first screen. In academia, it is more gratifying because you can see compounds move into the clinic. In industry, the more the compound progresses, the less you hear about it.

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SELLING IDEAS TO UPPER MANAGEMENT

A WELL THOUGHT OUT PRESENTATION IS STEP ONE by John K. Borchardt, Ph.D.

Effectively selling your ideas and those of your staff members to upper management is often what separates good lab managers from great ones. Great research and technical service ideas won't be funded unless you convince your upper management that the ideas are feasible and will be profitable. Failure to accomplish this is the main reason excellent ideas fall by the wayside. To sell ideas, you need to tap into the same creativity you and your staff used to conceive them. How do you do this?

"To sell ideas, you need to tap into the same creativity you and your staff used to conceive them."

Beginning the process

The idea sales process is the same for you as a lab manager whether you are taking your own idea or the idea of a staff member to funding authorities. It is also the same if you are a staff member yourself. Begin by documenting your idea. An entry in your laboratory notebook that is signed, dated and witnessed is the best way to do this. To share your idea with others, make sure it is documented in your laboratory notebook and in a dated "note to file." This will protect the ownership of your idea should someone else try to take credit for it. Should the idea be an invention, your laboratory notebook entry and note to file will establish a date for its conception and help a patent attorney determine who is to be designated as inventor on the patent application.

Next, discuss the idea with your coworkers and supervisor to refine it. Veteran employees in particular may have valuable insights based on previous research projects in related areas. As you talk to others, try to generate related ideas that can modify your original proposal into a network of ideas. Then if one aspect of your idea doesn't develop as desired, other aspects may still be feasible. If funding authorities decide not to fund one idea in your network, they may still approve others.

'Preselling' your idea

Informally talk to people to whom you are selling your idea. This "preselling" makes it easier to anticipate questions and concerns when you formally try to sell the idea. This approach is suited to inventions, customer service ideas and ideas for laboratory procedures. For example, a new manufacturing process may be used to produce additional products other than the one you initially proposed. A new product may have other markets besides the one you originally envisioned. Proposed new safety practices may have many applications, not just one.

So how can you generate these related ideas? Not rushing off to immediately publicize your idea and request approval for it may give you time to develop related ideas that can become part of your idea network. Those who read your note to file and those to whom you must sell your idea may have their own suggestions. Organizing a brainstorming session among your staff members may generate others.

Oral and written presentations

Depending on your company culture, people will sell their ideas to funding authorities using an oral presentation, a written report or both. These proposals should be clear and concise. Your audience or readers are busy people. If you don't get to the point quickly, they may lose patience and "turn off." To communicate with your audience and readers, use terms your funding sponsors will understand.

Follow the veteran salesperson's advice to "sell benefits, not features." Emphasize the financial benefits, greater safety, greater efficiency or higher morale associated with implementing your idea.

A representative outline for your oral or written report should require these five steps:

1. *Summarize the idea.*
2. *Define the need for the idea. What problem will it solve?*
3. *Explain how the idea will make money for the company. Are there other benefits as well?*
4. *Define the resources needed. What will be needed to develop and commercialize the idea? How much money will it cost? How much time will it take?*
5. *Request a commitment. Following up on your presentation may be required to get a definitive, timely decision on whether it will be funded.*

Let's take a look at each of these steps.

Step 1. Summarize the idea.

Write a concise summary of your idea. This brief statement will help others to easily and accurately remember it. You can use this summary to open your written idea proposal. Also, practice saying it and time how long it takes you. It should be less than a minute and ideally no more than thirty seconds.

"Key to your idea is whether your employer has the necessary resources to develop and commercialize it."

Step 2. Define the need for the idea.

There is no point to the idea unless it meets a need in the marketplace. The best way to demonstrate that there is indeed a need is to collect statements from potential customers. I sold perhaps my two best ideas to management this way. I was very familiar with the two industries concerned through previously developing products for them and providing technical service, so I was able to have credibility when approaching potential customers and generically describing what the product would do. In addition, potential customers often discuss these problems in trade journal articles and papers presented at trade conferences. I cited their oral and written comments when making my case to management, noting that my employer could earn substantial profits by initiating projects to solve these problems.

Getting customers to assign an economic value to solving their problems can be difficult, but even vague statements can be helpful. Of course, the greater the economic benefit to them of solving a problem, the higher the price your employer can charge for a solution to that problem.

In either your written or oral idea proposal, a summary of the need for the idea should immediately follow your description of the idea. Using this approach may require timely submission of patent applications, both in the U.S. and overseas, to prevent other firms from appropriating and commercializing your idea.

Step 3. Explain how the idea will make money for the company.

You need to understand and describe to your audience or readers how your idea will earn additional profits for your company. Usually, your problem solution must fit with the way your company currently manufactures and sells its products. For instance, if your employer is not a catalyst manufacturer or a polyethylene producer, an idea for an improved catalyst to make polyethylene more efficiently is not relevant to current business interests.

This is not to say that one can't sell an idea that will drastically transform a company. However, the financial benefits of adopting the idea must be very large indeed. For instance, Monsanto was a large chemical company when the firm began to move into biotechnology. Robert Fraley, head of Monsanto's plant molecular biology research team, persuaded executives that genetic engineering offered the best prospect of preserving the commercial life of Monsanto's most important chemical product, Roundup herbicide, after its key patent expired in 2000.[1] His strategy was to genetically modify seeds of major agricultural crops so they were highly resistant to Roundup. As a result, Roundup is highly selective in killing weeds without harming crops.

In 1982, Monsanto scientists were the first to genetically modify a plant cell. Five years later, Monsanto was

field testing genetically modified crops. Through a series of acquisitions and spinoffs beginning in 1997, Monsanto shed most of its chemical operations and transformed itself into a biotechnology company. The firm now focuses on agriculturally related biotechnology, particularly genetically modified seeds for corn, cotton, wheat and other agricultural crops. The seeds are genetically modified to be resistant to Roundup glyphosate herbicides, which are still sold by Monsanto.

▲ *Monsanto laboratory greenhouse. Image courtesy of Monsanto Company.*

Step 4. Define the resources needed.

Before deciding whether to approve your idea, executives will need to know what resources are needed to bring your idea to fruition. Key to your idea is whether your employer has the necessary resources to develop and commercialize it. Even if it does, other projects may be competing for the same resources. If it doesn't have the necessary resources, all is not necessarily lost if you can propose a joint effort with another firm that does have the resources your employer lacks. However, in considering a joint effort, your firm cannot expect to retain 100 percent of the profits. What can it reasonably expect to retain? How can it keep control of the idea and be the entity that develops and commercializes it? These are questions that you as the presenter of the idea need to consider. While you may not wish to include all the details in your presentation or report, you should be prepared to answer questions on these subjects.

If your idea is expensive and broad in scope, you may need to hire a consulting firm to determine the potential market for the product. Alternatively, this may be something your firm's marketing staff or even you may be able to do.

Step 5. Request a commitment.

Make it clear what the next step is that you are asking upper management to take. This includes the funds, staff, facilities, man-hours and time needed to implement the idea. Depending on the scope of your idea, you may need to hire new staff members, buy new lab equipment, set up a pilot plant, etc.

Final thoughts

You may find you need to sell your idea in stages. Be politely persistent until you get a concrete "yes" or "no" answer. Be prepared for disappointment. Sometimes "no" is the right answer.

However, don't let your idea die due to inaction.

If management rejects your idea, keep it in your file. Your idea may be a good one that was just submitted at a poor time. Changes in business conditions or technological advances may make it worthwhile to resubmit your idea later. Understanding the reasons for the idea's rejection will help you determine if and when to resubmit it. It can also help you when you submit other ideas.

Be sure you feel strongly about the ideas you do submit. If you are doubtful of an idea's feasibility, that's usually a signal that the idea has a major flaw.

Submitting many ideas from you and your staff does not mean more ideas will be approved. However, it does mean that the quality of the ideas developed into projects will be higher. So encourage your staff members to submit their ideas for new products and services.

Preparing staff members to do so can be an excellent mentoring opportunity for lab managers with successful track records of selling their own ideas to upper management. To prepare staff members to sell their ideas, coach them on how to do so. If you have more than one inexperienced staff member, you may wish to offer a short workshop on how to sell ideas based on this article. An additional way to help prepare them is to bring them to a meeting where you or other staff members will be presenting ideas to business managers.

Effective selling means that good ideas are implemented by you and your employer, not by your competition. This can only be good for both you and your employer.

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MANAGING THROUGH CHALLENGING TIMES

"BUSINESS AS USUAL" IS SIMPLY NOT AN OPTION by Shanya Kane

This article is based on a transcript of the speech Shanya Kane delivered at the 30th Annual ALMA Conference in Atlanta, Georgia, this past October.

Predicting the future is always risky, but we can make pretty good guesses by simply extrapolating the major trends that we see today. For example, multinational companies have been shifting R&D and manufacturing facilities to Asia for more than two decades, so we can guess that this trend will continue as these companies exploit opportunities in these high-growth emerging markets. Environmental concerns, especially around global warming, are already beginning to produce legislation that will place limits on the future operations of chemical and petroleum industries. Competitive pressures and industry consolidations have forced significant budget and staff cuts for more than a decade, so it is likely that executive management will continue to ask for even more reductions in the coming years.

"Most managers struggle just to meet their daily operational obligations and... lack the time and resources to invest in improving their processes."

Another amazing trend is the broad application of biotechnology within the chemical and pharmaceutical industry. In addition to creating new products and whole new industries—as in the case of biopharmaceuticals and biofuels—decades-old technologies for the production of basic chemicals are now being re-examined for production by cheaper biological-based processes. Public safety and security are now getting increased attention with the recent food safety issues and the continued threat of terrorism. We can guess that the public will demand improved vigilance in these areas and that these industries will continue to grow at an exceptional rate.

And lastly, population demographics foretell the greatest mass exodus from the workforce in history, with the impending retirement of the baby boomer generation beginning in 2011. Just consider how many people will reach retirement age within the next 10 years, and think about the loss of technical and organizational knowledge from the workplace. So, what will all these trends mean for laboratory managers?

At one time, laboratories were relatively insulated from business influences and were largely left to concentrate on science. Everyone knows that this is no longer the case—laboratories are now considered just another business function to be measured in hard business terms. Social and business trends have already impacted the way that labs operate and have affected their status within the business. The past decade has been a difficult one with declining resources and, unfortunately, there is no reason to expect that the situation will change in the coming years. Laboratories face an uncertain future of more work, fewer resources, more bureaucracy, less discretionary time, more data reporting requirements, and fewer experienced people with the knowledge to handle these issues. What this means for the lab manager is that "business as usual" will simply not be an option.

Since these trends are not unknown to most lab managers, one might expect that labs are already gearing up to meet these challenges. However, that does not seem to be the case. We find that most managers struggle just to meet their daily operational obligations and that they lack the time and resources to invest in improving their processes. They worry about providing adequate coverage for all required testing each day, about meeting customer needs, about solving problems for the business, about keeping a safe workplace, about improving the skills of analysts, about data bottlenecks, and about the countless other details necessary to meet their customers' expectations. Lab managers seem to operate by simply dealing with the next new issue. How did we get to this point?

Across the laboratory industries, we find that staff reductions of 50 percent or more over the past decade are not uncommon. Where labs were previously able to offer high-level, even expert problem-solving services and had discretionary time to devote to improving their internal processes, most are now challenged just to keep up with the daily workload. Budgets are sparse, bench work is often done by analysts with limited skills and no science training, and the trained chemists who do remain on staff spend their time triaging the daily barrage of customer problems or managing a growing list of projects. With the resource constraints, it is only natural that lab managers are slow to devote time and manpower to projects that will improve their internal operations, until they are forced to do so—the needs of today's customer come first. The irony of the situation is that this "manage for today" approach leaves many labs using outdated, inefficient methods and processes that rob them of the productivity that would lessen their burden.

So, what is the solution? Well, it is fairly obvious that labs will eventually have no choice but to take action to increase productivity as resources are further reduced and workloads continue to increase. Labs have done an outstanding job in redeploying resources and streamlining processes over the past years just to maintain operations, but now the easiest gains are gone; to deliver on the increased expectations from the business, managers will face tough choices. If we look at the options, there are three levers that managers can use to gain productivity—improve processes, improve labor effectiveness, or employ technology.

The lab's most important processes are its test methods, so we can gain productivity by making them faster—doubling the speed of a test doubles the number completed in a day or halves the time required to perform the same number of tests. This is fertile ground for improvement for most labs since it is not uncommon for methods to go unchanged for years without incorporating the latest time-saving technologies. To improve labor effectiveness, the manager can demand more effort from the staff or help them to work smarter. Obviously, the preferred option is to help them to work smarter by providing more training, including cross-training, to increase flexibility in deploying resources to where they are most needed. And the third lever, technology, simply means making judicious choices where automation can effectively replace human effort. Each of these

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options will be somewhat disruptive to normal operations, but fortunately the marketplace can help.

In the past, instrument companies such as our forebear Hewlett-Packard could simply design new, technologically advanced instruments and the laboratories would buy them, do all the work to set them up, and develop the methods for their own uses. That business model is becoming a rarity. More and more labs are dealing with their resource shortages by pushing development activities back onto the instrument manufacturer.

We are now being asked to supply "analyzers," which includes the instrument, hardware modifications, standards, validated methods, software, expendables, and training needed to perform specific tests that have been factory checked and are ready for use upon installation. For example, rather than simply sell a GC-QQQ, we might now sell a pesticides residue analyzer to a food or environmental lab, or perhaps rather than a GC, the refinery customer might purchase a fast, simulated distillation solution with automated sample preparation. We find that instrument vendors are now doing more of the analytical development to jump-start the introduction of a new application in order to compensate for expertise lost during downsizing. And we see this trend continuing as we are asked to provide more complete workflows to streamline sample preparation and data handling as well as perform the actual analysis. In the coming years, we expect that more and more of a lab's development tasks will be delegated to laboratory suppliers and that labs will increasingly look for complete workflow solutions. These vendor-supplied workflows provide a convenient solution to the productivity conundrum—rather than devoting valuable lab resources to the development of new, super-fast methods employing the latest technology, the lab will simply purchase these solutions.

Fortunately, the market anticipated these needs several years ago and is well prepared to deliver a broad portfolio of solutions. Many of the productivity solutions needed to free additional staff time by automating and increasing the speed of tests are already developed and waiting to be implemented. Now, to finish the job, lab managers must adopt a new focus on productivity. The key for managers is to evaluate the benefit of each proposed solution, using rational business tools to make the best business decisions for their own unique situation. This requires lab managers to make the transition from scientist to businessperson in order to use business tools to make informed decisions regarding which solutions are cost-effective and which are not.

Nearly all lab managers are trained in the sciences, and most still maintain the perspective of a scientist. Adopting a business perspective simply requires applying analytical skills in a different manner. Business activities will never follow the predictable paths of a chemical reaction, but standard business tools provide reasonable estimates of the outcomes to guide decisions. There are rational quantitative methods to evaluate the cost versus the benefits of each workflow solution offered in the marketplace for each lab's own unique situation to decide which are worth the cost in time, effort, and money. If the solution is not a cost-effective replacement for the current method, then it should not be purchased—but the manager is obligated to do the math to make an informed decision. Managers can no longer afford to rely on attributes of the instrument or specifications to make purchase decisions, but are expected to select products based on maximizing value to the business.

What else is involved in the transition from scientist to businessperson? The successful transition from scientist to manager requires a change in mind-set to adopt a broader view of the lab's mission beyond just the discovery and application of the science or generation of analytical results. Managers are expected to adopt a market perspective to appreciate how their efforts are used to fulfill each stakeholder's needs, whether internal or external. They, above everyone else, must be cognizant of the expectations of their ultimate customer, and must provide the leadership and vision to explicitly define those expected contributions and to apply human relations skills to influence the staff to deliver them. And, most important, managers must look beyond the boundaries of the laboratory to optimize total business

value rather than just internal operations. Reducing lab costs might be a desirable goal, but not if it detracts from the business. For example, lowering the lab's cost by reducing testing might lead to lost sales, more off-specification products, slower time to market for new products, additional warranty claims, or other consequences that hurt the organization. That is why investments in new, faster workflows usually make good business sense—they lower lab costs by reducing test labor requirements without sacrificing the benefits to customers.

"...managers must look beyond the boundaries of the laboratory to optimize total business value rather than just internal operations."

Those of us who serve the laboratory industry realize that our success depends on the success of our customers, and we will continue to invest in new technologies, products, and workflows to allow our customers to remain competitive. There are opportunities to provide solutions to alleviate the sample preparation and data processing/handling bottlenecks that occur in most labs. LIMS has become a necessity in most labs, but we are finding that it can also be quite difficult to integrate into seamless workflows. So, there is a need to improve the connectivity and ease of use of our applications with these systems. Lab managers need improved tools to build the business cases for their investments and more metrics to instantly convey the operational status of their labs. And of course, no instrument is productive if it is not working properly, so labs need an array of service options that can be justified business-wise for their particular situation—even if they are self-maintained. In summary, we will continue to improve our understanding of your needs for what we believe is the most demanding job in the laboratory and to look for ways that we can make your job a bit easier.

Lab managers must lead the way to greater productivity in order to continue to meet their organization's expectations and remain competitive. Start preparing today by building a multiyear productivity improvement plan around faster methods, practical automation, and staff training. Avoid obsolescence by budgeting replacement of old technology, using business justifications built around both lab and customer benefits. Consider the effects of retirements during the next decade, and find ways to capture essential organizational knowledge. And last, involve your key suppliers to help you implement your plan.

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EVOLUTION OF GAS CHROMATOGRAPHY

BY JOHN BUIE

While the history of gas chromatography (GC) dates back to the first experiments of Mikhail Tsvet separating plant pigments using paper chromatography in 1903 to Schuftan & Eucken introducing vapor as the mobile phase in the 1930s, the evolution of modern GC systems is a very competitive race to resolution and usability. Let's start with the first instruments—introduced more than 50 years ago—that somewhat resemble the GC systems used in labs today.

1955 – The lab bench was populated with analytical instruments that only skilled scientists could operate. PerkinElmer set out to make GC more accessible to researchers by introducing their first gas chromatograph, the Model 154 Vapor Fractometer. This was the first ever gas chromatograph to use an oven to adjust the column temperature, a flash vaporizer and a syringe injection.

1959 – GOW-MAC, whose roots date back to developing thermal conductivity detectors (TCDs) in 1935 to measure the carbon dioxide content of exhaust gas for customers such as the U.S. Navy during World War II, developed a revolutionary new technique named gas chromatography.

1961 – Researchers were finding new applications for temperature-programmable instruments. In response, PerkinElmer developed the Model 222, which attached to the 154 Vapor Fractometer via its detector. The Model 222 is the first gas chromatograph with a resistance-heated packed column, which removed the delta between set and actual column temperatures.

1962 – In Germany, PerkinElmer's affiliate was building the world's first modular gas chromatograph. The new PerkinElmer Model F-6 was a building block system that allowed one to choose from multiple detector combinations and isothermal or programmed temperature operation.

1967 – The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (Pittcon) to this day remains the most important industry trade show in the scientific industry, and over 30 years ago that held true as well. There was no better forum for PerkinElmer to release its first flagship gas chromatograph, the Model 900, which continued to dominate the GC market for the next decade. The Model 900 introduced several improvements, including the ability to use two columns and multiple detectors, setting a new bar in flexibility and sophistication.

1969 – Seeing a need in the research arena for a lower priced, easier-to-use gas chromatograph, GOW-MAC launched its own line, beginning with their Model 69-100.

1973 – Hewlett-Packard (HP), introduced its first gas chromatograph, the HP 5830, which was also the first microprocessor-controlled analytical instrument ever made.

1976 – The XII Olympic Winter Games in Innsbruck, Austria proved to be the testing ground for the newest gas chromatograph in the PerkinElmer line, one that at an affordable price could rapidly perform drug screening for routine testing of athletes. The Model 3920 delivered, making it one of their most successful instruments.

1976 – Evolving their existing gas chromatograph with mass spectrophotometer (MS) detection capability, HP introduced the very first benchtop GC/MS system—the HP 5990.

1979 – Responding to the need for simplified chemical analysis and more compounds to be analyzed, HP developed fused silica capillary columns for gas chromatography.

1980 – Hearing of HP's revolutionary use of fused silica capillary columns, Dr. John Lipsky, an innovator in GC technology, sought suppliers of the new flexible tubing and formed Quadra, which released the "Black Knight," the first mass-produced GC column.

1981 – Shimadzu launched the GC-8A, which changed GC system design by offering a smaller, compact size and a solid, die-cast frame.

1984 – To this day, the all time best-selling GC is the HP 5890, released 25 years ago. It's still one of the most active instruments in equipment marketplaces—just search "HP 5890" on www.LabX.com

1986 – The new generation of GC system hardware made new applications, which were performed at high temperatures, available to researchers. This is when Quadrex introduced the first aluminum-covered silica columns to tolerate these high temperatures.

1989 – With the evolution of the GC system and new software, the demand for a broader range of application-focused detectors grew. GOW-MAC patented the Discharge Ionization Detector (DID) and revolutionized the gas industry. This universal, non-radioactive detector capable of performing trace gas impurity analysis in the ppb range quickly became an industry standard.

1989 – Making the gas chromatograph easier to control required more advanced software with better user interfaces. HP released another best seller, the ChemStation software for both GC and HPLC.

1995 – Building on an already impressive platform, HP released the 6890 series of gas chromatographs, setting a new standard for the next generation of GC systems.

1996 – With the new 6890 platform in the field for a year, the next generation of GC/MS configurations was not far behind. HP introduced the 5973 GC/MSD.

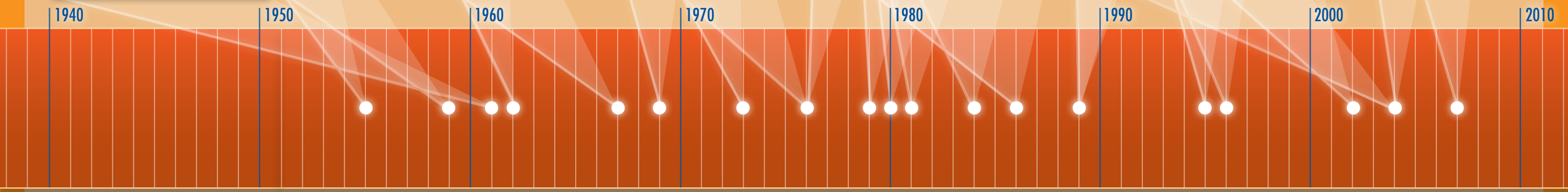
2002 – With ease of use still being a drawback to GC systems, PerkinElmer revamped its user interface and introduced the first touch-screen display based graphical user interface to its Clarus 500 gas chromatograph and GC/MS lines.

2004 – The first X-ray diagnostic system equipped with a direct conversion flat panel detector (FPD) is launched by Shimadzu with the release of the GC-2014.

2004 – With 17 associated patents behind the Varian 4000 GC/MS, a breakthrough in GC flexibility now becomes available to researchers. The system allows users to choose from three separate ionization configurations to increase application-specific performance. The three configurations include Internal Ionization, External Ionization and Hybrid Chemical Ionization, which allow users to select a suitable chemical ionization (CI) reagent and separate specific reagent ion for reaction with sample molecules.

2007 – After being spun off from its parent company, HP, newly named Agilent Technologies, released the 7890A GC. This new model incorporates capillary flow technology.

The Future of Gas Chromatographs - Masanao Furukawa of Shimadzu's MS/GC business unit made these comments regarding the future of the gas chromatograph: "By using heart-cut technology to view compounds in even more detail, a secondary column with different characteristics is used to conduct a more detailed analysis, and this type of method is referred to as multidimensional GC." He also added, "It can be expected that GC's will become more like sensor technology as higher speeds are achieved." GC manufacturers are confident that gas chromatography will continue to play an ever more important role in labs as the equipment continues to evolve to meet the demands of more challenging applications, as well as increasing efficiency in daily analysis.



IT'S MORE THAN JUST THE PORES

by Angelo DePalma

Filtration is the mechanical separation, based on particle size, of materials from fluids by using a porous membrane. Most laboratory filtrations involve the removal of solids from liquids; gas filtration based on molecular weight is common in industrial processes but less so in the lab. Although filtration appears simple conceptually, the physics and mathematics underlying it are complex and still yield interesting insights after hundreds of years of study.

"Polymeric membranes are by far the most common in analytical lab settings for water-based filtration."

Polymeric membranes are by far the most common in analytical lab settings for water-based filtration. Plastics, including Teflon, nylon, polyethersulfone, and polyvinylidene fluoride, provide almost limitless opportunities for pore size and surface chemistry and for designing pore channels for specific separations.

Important considerations for lab filtration include the following:

- Throughput – how much fluid can pass through individual filters before they clog, or how many samples can be run per unit of time
- Chemical compatibility with the process fluid
- Time/cost of filter or sample preparation
- Ability to validate filtration operations, particularly for regulated industries

Filtration most commonly involves the size-based isolation of insoluble particles from a liquid medium that may be aqueous or organic. Many lab filtrations, particularly those involving nonviscous organic solvents, occur spontaneously under the gravitational pressure of the fluid against the filter medium. An example is the removal of drying agents from hexane. But for many aqueous filtrations, operators apply pressure above the filter medium or create a vacuum below it to force fluid through.

Simplistically, filtration works because particles larger than the filter medium's nominal pore size are retained while smaller ones pass through. In practice the situation is more complex. The filter medium—e.g., paper, polymeric membrane, or glass frit—may appear flat but is actually three-dimensional, with pores resembling complex channels more than smooth chutes. As filtration proceeds, particles accumulate at the pore surface and within the filtration medium, blocking access to the pores. In preparative filtrations, the filtrate—the solids removed from the suspension—form a cake atop the filter medium. As a result, greater pressure must be applied to push fluid through. Eventually the filter may clog completely. This phenomenon, quite common in industrial filtration, also arises in the laboratory.

Filtration is distinct from sieving, which involves the straightforward separation of solids from other solids on the basis of physical dimensions. Channel effects play no role in sieving.

Analytical filtration

Although filtration is most often thought of as a preparative operation, analytical filtration of suspended solids in water is a major application in environmental laboratories. Manufacturers that produce wastewater perform this test routinely to assure regulators that their effluent meets safety specifications.

The technique involves passing a standard volume of liquid through a preweighed filter, drying the filter, and reweighing. The difference in mass corresponds to the concentration of undissolved particles per unit volume of wastewater.

EPA methods are quite specific as to how the filters and samples are prepared and handled before the analysis. A typical preparation involves rinsing the filter with a specified volume of deionized water, drying at 105°C, cooling, and weighing on a balance to within 0.1 mg. Handling before the weighing step is specified as well.

Another interesting analytical application of filtration is metal digestion, a process for quantifying metals that uses acid and heating to convert soluble metals into insoluble particles, which may then be isolated on an appropriate filter membrane.

Preparation of analytical filter membranes consumes a significant amount of operator time, says Joe Boyd, a technical specialist at Environmental Express (Mt. Pleasant, SC), which manufactures filters and other equipment for environmental labs. Customers therefore increasingly demand filters that are pre-treated, -weighed, -dried, and ready to use. "All of our weighing and prepping is carried out robotically," Boyd tells *Lab Manager Magazine*, and for environmental applications the filters are strictly single-use.

Filtration is used routinely to prepare samples for injection into HPLC and GC, to prevent particles from clogging columns. The most common form of chromatographic sample filtration, according to Larry Scheer, senior product manager at Pall Life Sciences (Ann Arbor, MI), involves syringe filters. These small, disposable membranes attach to the end of a syringe via a Luer lock and are quite popular in regulated industries.

Filtration is also used to prepare HPLC mobile phases, for example, organics such as acetonitrile, aqueous buffers, or mixtures. "Operators are looking to remove non-dissolved particulates to protect the instrument and column and cut down on maintenance," Scheer says. A 47 mm polymeric disk will typically process up to two liters of mobile phase. Customers interested in this application are most often concerned with chemical compatibility, particularly of leachables and extractables. "You don't want your filter contributing to the chromatogram," he notes.

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Filters

Advantec MFS	Dublin, CA	800-334-7132	www.advantecmfs.com
Aries Filterworks	West Berlin, NJ	856-768-9600	www.arieswater.com
Aqua Solutions	Jasper, GA	800-458-2021	www.aqua-sol.com
Environmental Express	Mt. Pleasant, SC	800-343-5319	www.environmentalexpress.com
Millipore Bioscience	Danvers, MA	978-762-5147	www.millipore.com
Pall Corporation	East Hills, NY	800-521-1520	www.pall.com
Sartorius Stedim	Bohemia, NY	800-368-7178	www.sartorius-stedim.com
Siemens Water Technologies	Warrendale, PA	866-926-8420	www.usfilter.com
Sterliech Corporation	Kent, WA	877-544-4420	www.sterliech.com
Thermo Fisher Scientific – Nalgene Nunc	Rochester, NY	800-625-4327	www.nalgene.com
Tisch Environmental	Cleves, OH	513-467-0222	www.tisch-env.com
Whatman Inc./GE Healthcare	Florham Park, NJ	800-942-8626	www.whatman.com
Wheaton Science Products	Milville, NJ	800-225-1437	www.wheatonsci.com

VERSATILE, ON-DEMAND ISOLATION OR CONTAINMENT

by Angelo DePalma

Glove boxes are completely closed compartments ranging in size from a few cubic feet to several hundred cubic feet. Glove boxes differ from other safety enclosures in two significant respects: users can introduce articles into glove boxes and manipulate them inside through ports fitted with gloves, and glove boxes typically use a specialized atmosphere.

"Materials of construction are a significant glove box feature."

Glove boxes consist of the main chamber, two glove ports, and an air-locked antechamber for introducing labware and materials into the box. Opening the antechamber without taking preventive measures will introduce ambient atmosphere into the working chamber. This is dealt with by providing vacuum-assisted purging with the desired atmosphere. Sensitive applications will often add sensors for oxygen and/or water, with some type of scavenger mechanism to achieve ppm concentrations of those species. In regulated industries, the purge cycle is software-controlled and documented to ensure that materials are handled to specification.

"Glove boxes go under many different names and are used for many purposes," says Mike Buckwalter, publications director at Terra Universal (Fullerton, CA). "Their essential attribute is the ability to maintain a completely separate environment from ambient."

Although glove boxes are most often associated with biology, all scientific and engineering disciplines use glove boxes for one application or another. For example:

- Semiconductor/electronics – maintaining cleanliness for microchips or fabricated parts, sensor calibration
- Chemicals – manipulating dangerous, toxic, or moisture-sensitive substances
- Foods – air- or moisture-sensitive analyses
- Biology – cell culture, virus production
- Pharmaceuticals – compounding pharmacy, vaccines
- Controlled-atmosphere welding

Glove boxes are most commonly used when a process or operation requires low humidity or low oxygen levels, or when either the product/process must be protected from the lab environment or the operator needs protection from the process or operation. One often hears the terms "isolation" and "containment" with respect to glove boxes. Isolation is meant to protect the product, while containment refers to protecting the operator and/or environment. Isolation normally involves positive pressure, while containment operates under negative pressure.

"Containment and isolation are the major differentiators," says Bob Applequist, product manager at Labconco (Kansas City, MO).

Materials of construction

Materials of construction are a significant glove box feature. Acrylics are transparent and low-cost, but life science applications that demand sterility require boxes made of sturdier materials that hold up better to cleaning and constant use. Stainless steel is most easily treated with a variety of cleaners and is the most durable material of construction, but also the most expensive. Most pharmaceutical glove boxes are made of stainless steel with sanitary fittings, as is required by Good Manufacturing Practices.

When static control is an issue, for example, when manipulating powders or combustible materials, acrylics are definitely out. Here, purchasers often specify stainless steel, which dissipates charges to ground, or electrically dissipative polyvinyl chloride.

Glove boxes may be positively or negatively pressurized, up to about 6 inches of water (17 inches equal one atmosphere). Pressurization puts strain on seals and limits the materials of construction, as large plastic or glass windows cannot withstand high pressures.

Top vendors will manufacture custom boxes, but most needs are served by off-the-shelf designs, with or without add-ons. For example, Terra Universal has several standard plastic and stainless steel designs, according to Buckwalter. "We try to avoid customization as much as possible by integrating standard modules with additional functionality, for example, gas filtration, controllers, sensors, automated doors, heating and cooling capability, and humidity control."

Price, value, performance

A quick online shopping search for "glove box" leads to a dizzying array of devices ranging in price from $411 to $50,000, from simple plastic boxes to sophisticated mini–clean rooms that meet ISO sterility requirements. Glove boxes for regulated industries will almost always include pressure gauges, validatable oxygen and moisture monitoring, and built-in data transmission.

According to Applequist, price is the principal factor affecting most glove box purchase decisions. "Most of our customers have to watch their budgets."

Any glove box can achieve very low oxygen or moisture readings, he explains, "but the cleaner it is on the inside relative to the outside, the greater the equilibrium difference." Without taking additional measures, he says, "oxygen and moisture can creep up to 10 percent in 10 minutes."

Customers, he says, often over specify for oxygen and moisture removal based not on actual data but on perception or assumption. "They know they want low oxygen and moisture, but when you ask them how low, 95 percent don't really know. Maintaining 1 ppm levels 24 hours a day will be quite expensive, particularly with respect to scavenger systems."

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Glove Boxes: Are you using a glove box in your lab? Are you considering purchasing a glove box soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/glove-boxes

Glove Boxes

Coy Laboratory Products	Grass Lake, MI	734-475-2200	www.coylab.com
Innovative Technology	Newburyport, MA	978-462-4415	www.gloveboxes.com
Labconco	Kansas City, MO	816-333-8811	www.labconco.com
LABREPCO	Horsham, PA	800-521-0754	www.labrepco.com
La Calhène – Getinge	Rush City, MN	320-358-4713	www.lacalhene.com
LC Technology Solutions	Seabrook, NH	603-926-5400	www.lctechinc.com
MBraun USA	Stratham, NH	603-773-9333	www.mbraunusa.com
MTI Corporation	Richmond, CA	888-525-3070	www.mtixtl.com
NUAIRE	Plymouth, MN	800-328-3352	www.nuaire.com
Plas-Labs	Lansing, MI	800-866-7527	www.plas-labs.com
Plastic Concepts	Billerica, MA	978-663-7996	www.plastic-concepts.com
Terra Universal	Fullerton, CA	714-578-6000	www.terrauniversal.com
The Baker Company	Sanford, ME	800-992-2537	www.bakerco.com
Vacuum Atmospheres Company	Hawthorne, CA	310-644-0255	www.vac-atm.com
Walker Barrier Systems	New Lisbon, WI	608-562-7700	www.walkerbarrier.com

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AUTOMATED, HIGH-PRECISION QUANTITATION OF KNOWN CHEMICALS

by Angelo DePalma

Titration is a common laboratory operation for quantifying chemicals or reagents, usually in aqueous solution. In a typical setup, the titrand—the solution containing the unknown—is treated with precise volumes of a standard solution of the titrant—the reagent of known strength. The titration end point is reached when a chemical balance is achieved between the titrant and titrand. The concentration of the unknown in the original sample is calculated through simple equations related to the applicable chemical stoichiometry and any dilutions that may have occurred during sample preparation.

Many scientists first experienced titrations during acid-base laboratory exercises in first-year chemistry class. While pH determination remains a popular application, the range of chemicals amenable to analysis by titration is huge and includes many metals and nonmetallic elements as well as specific compounds. Titrations may be based on oxidation-reduction (redox), metal complexes, zeta potential (for measuring colloids), amperometry, and other modalities.

Unlike spectroscopy, which can help identify (and often quantify) unknown compounds through their absorption of electromagnetic radiation, titration is limited to measuring concentrations of *known* materials. "Titration is used to quantify something you already know is there," says Tore Fossum, technical director at Mettler Toledo (Columbus, OH). Nevertheless, the technique has become a mainstay in analytical laboratories serving practically every industry, including chemicals, materials, environmental, and foods, to support quality control, process monitoring, or regulatory requirements.

"The range of chemicals amenable to analysis by titration is huge."

Common titration analyses include measurement of salt in potato chips, moisture in pharmaceuticals (e.g. the Karl Fischer redox method), heavy metal content of water/wastewater, iodine levels in solution, biological activity of enzymes or substrates, peroxide solution strength, wine acidity, pH of biological buffers, and many others.

All titrations require some type of indicator to alert the analyst that titrant and titrand are stoichiometrically balanced. Chemists are familiar with the range of colorimetric indicators for various pH ranges and the color-changing reagents or signals in redox titrations. Another common visual indicator is precipitation. Analysts also use instrumentation to detect end points by changes in solution conductivity, heat absorption, and appearance of species that absorb specific wavelengths of light.

Although titration can be extremely precise, numerous sources of error exist, for example, measurement of the titrant aliquot, indicator variability, operator fatigue and computation error, anomalies in composition of the standard solution, accuracy of the delivery system, and other systemic and nonsystemic errors. Titrators are specialized instruments that perform titrations with minimal operator intervention and can thus minimize errors, improve throughput, and facilitate documentation.

Titrators: Are you using a titrator in your lab? Are you considering purchasing a titrator soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/titrators

Enter automation

Fossum notes from his own experience that manual titration takes time—up to 30 minutes for measurement of acids in fuel oils, for example. "Today you can put your sample in a beaker, push a button, and walk away to do something more productive." He recalls that one company where he worked employed as many as a dozen operators who performed routine titrations for quality control. Despite their experience, systematic errors crept into the workflow but were eliminated when the company switched to automated titration.

"Compared with manual titration, a titrator will save time and improve the quality of the result," he says, "while freeing workers to do things that are more productive."

Mettler Toledo sells most of its titrators as stand-alone instruments, but add-ons such as sample changers can improve throughput dramatically for high-volume labs. Data management is another important feature, particularly for regulated industries that must document laboratory activities in formal reports. Titrators in pharmaceutical and environmental labs are increasingly connected to LIMS (laboratory information management systems), which tabulate and output data in approved formats.

"Titrators are specialized instruments that perform titrations with minimal operator intervention."

Advanced titrators also incorporate onboard computers for storing and accessing methods, and that may record results locally. Touch-sensitive flat-panel displays allow users to select and deploy methods through visual menus.

Additional differentiators, according to Robert V. Menegotto, business development manager at Mandel/Man-Tech (Guelph, ON), are software ease of use, user-configurable functions and routines, flexibility of automation ("how many samples can run unattended?"), the ability to run several titrations for multiple analytes in a single sample, and integration of spectrophotometric or other measurement techniques for advanced analysis and end point determination.

The importance of accuracy in delivering titrant cannot be underestimated. "Unlike human operators, a titrator equipped, for example, with a pH electrode automatically senses the end point approaching," Menegotto says. "It will automatically inject smaller quantities than an operator could with a traditional stopcock burette. And there's no operator bias, which means you get more accurate results." Menegotto notes that automated titrators can deliver titrant aliquots as small as 0.2 microliters, which is impossible from a standard burette.

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Titrators

AQUACOUNTER®	Grand Island, NY	800-495-1678	www.jmscience.com
Denver Instrument Company	Arvada, CO	800-321-1135	www.denverinstrumentusa.com
EST Analytical	Fairfield, OH	800-283-3510	www.estanalytical.com
Hach Company	Loveland, CO	800-227-4224	www.hach.com
Man-Tech	Guelph, ON	519-763-4245	www.titrationplus.com
Metrohm	Riverview, FL	800-727-6768	www.metrohmusa.com
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Radiometer Analytical	Lyon, France	+33 (0) 478-03 3838	www.radiometer-analytical.com
Sigma-Aldrich	Bellefonte, PA	814-359-5452	www.sial.com

SURROGATE MEASUREMENT FOR CHEMICAL, BACTERIAL CONTAMINATION

by Angelo DePalma

A mainstay of environmental and quality control chemistry, total organic carbon (TOC) analysis measures the carbon content of dissolved and particulate organic materials in water. The carbon measured in TOC analysis may arise from any combination of living or dead organisms and chemical contamination.

"TOC analysis... tells how much organic carbon is present without identifying the contaminant."

Water utilities monitor TOC to determine raw water quality, to measure the effectiveness of organic carbon removal, and to monitor the efficiency of treatment processes. For example, water utilities use TOC to monitor by-products of chlorination or ozonation. TOC often serves as a surrogate for more difficult measurements, for example, contamination from petrochemicals, solvents, pharmaceuticals, chlorinated industrial chemicals, and pesticides. It can also act as a screen for additional analysis. For example, pharmaceutical manufacturers might use liquid chromatography-mass spectrometry to analyze water samples containing unacceptable TOC values.

As a quality measure, pharmaceutical regulatory authorities in the U.S., Europe, and Japan require TOC analysis of ultrapure water used in biotechnology, to ensure the absence of contaminating bacteria.

TOC analysis is nonspecific, meaning it tells how much organic carbon is present without identifying the contaminant.

How it's done

The two main approaches to TOC measurement involve either initial removal of inorganic carbon (mostly carbonate) followed by TOC measurement, or the subtraction of inorganic carbon from total carbon present. The four steps in TOC measurement are acidification to remove inorganic carbon, purging to release volatile organics (which are measured separately), oxidation of the remaining carbonaceous material, and detection.

The latter two operations form the heart of TOC analysis. Several types of oxidation may be used: high- or low-temperature combustion, catalytic oxidation, photo-oxidation, thermochemical oxidation, or electrolytic oxidation. "Each has its pros and cons," says Jeff Lane, a TOC specialist at OI Analytical (College Station, TX).

Detection is carried out through conductivity measurements, by nondispersive infrared (NDIR) spectroscopy of the strongly absorbing carbon dioxide oxidation product, or colorimetrically. The most common online TOC analyzers used for drinking water analysis use NDIR. "CO2 has a unique signature in the infrared," notes Lane. "It's possible to tune in specifically for it and rule out everything else."

Detection limits for TOC depend on the measurement technique used and the type of analyzer. High-temperature (up to 950ºC) oxidation produces a sensitivity of 0.1 mg/L of carbon, while low-temperature methods (below 100ºC) are only reliable to about 0.2 mg/L. Response times for TOC analyzers vary widely, but instruments generally take five to fifteen minutes to report stable readings.

Online TOC analyzers are capable of continuous, unattended operation, but regular calibration, inspection, and maintenance by skilled technicians is required for reliable operation.

Differentiators

Purchasers of TOC analyzers value ease of use, throughput, and automation features. "They want to be able to set up a group of samples and walk away while the instrument does its thing," says Lane. Another desirable feature is some sort of reporting and/or control function, which can be achieved by connecting analyzers to LIMS (laboratory information management systems), or for critical monitoring applications to a SCADA (supervisory control and data acquisition) or Ethernet network whose supervisory functions will close down a plant or process when serious excursions occur.

TOC analyzers are reasonably priced as lab instruments go. A basic unit costs approximately $20,000. Autosamplers will add to the cost, as will the addition of detectors for nitrogen or isotopic carbon. "Tandem detection systems are more common in research settings than in industrial laboratories," Lane says.

"Over the past decade, the popularity of TOC analysis has been driven by regulations," notes Steve Poirier, VP of business development at GE Power and Water (Boulder, CO). "Every pharmaceutical company that ships drugs into the U.S. and Europe is required to measure TOCs to certain specifications." In the drug industry, high-purity water is used both for cleaning and in sterile drug products.

The second regulatory front is the environment. According to Poirier, every municipality of greater than 10,000 population is required to control TOC to specified levels in drinking water.

"TOC analyzers are reasonably priced as lab instruments go."

"Additionally, some companies have demonstrated equivalency between TOC measurements and other tests and use TOC as the primary regulatory assay for releasing wastewater," Poirier adds. The advantages are that TOC analysis is straightforward and does not require the specialized skill set of chromatography.

User-friendliness is a desirable software feature, but Poirier notes that data management capabilities differ significantly among industries. "It's important that software serve the specific needs of the application." While LIMS capability is now common for TOC analyzers, drug companies, for example, will demand compliance with CFR Part 11, the FDA's mandate for electronic records.

A TOC analyzer's reliability and uptime are important factors, both for busy analytical labs and for online instruments that operate continuously. "But in the end, most purchase decisions are based on productivity, and that comes down to analysis time or throughput," Poirier says.

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TOC Analyzers: Are you using a TOC analyzer in your lab? Are you considering purchasing a TOC analyzer soon? Lab Manager Magazine's online surveys help improve the purchasing process and provide you with greater confidence in your final purchasing decision. To take the survey, please visit www.labmanager.com/toc-analyzers

TOC Analyzers

Analytik Jena	Jena, Germany	+49/3641 77-70	www.analytik-jena.com
EST Analytical	Fairfield, OH	800-283-3510	www.estanalytical.com
GE Analytical Instruments	Boulder, CO	800-255-6964	www.geinstruments.com
Hach Company	Loveland, CO	800-227-4224	www.hach.com
OI Analytical	College Station, TX	979-690-1711	www.oico.com
Parker Balston	Haverhill, MA	800-343-0051	www.labgasgenerators.com
Shimadzu Scientific Instruments	Columbia, MD	800-477-1227	www.ssi.shimadzu.com
Skalar Analytical	Norcross, GA	800-782-4994	www.skalar.com
Teledyne Analytical Instruments	City of Industry, CA	888-789-8168	www.teledyne-ai.com
Thermo Fisher Scientific	Waltham, MA	781-622-1000	www.thermo.com
TOC Systems	League City, TX	281-338-1388	www.tocsystemsinc.com
UIC	Joliet, IL	800-342-5842	www.uicinc.com

PERSPECTIVE ON: A MOBILE TRAINING LAB

The BioNetwork mobile laboratory.

The BioNetwork mobile laboratory has visited nearly 60 college campuses, such as Randolph Community College in Asheboro, North Carolina.

"The... laboratory conducts training in such areas as micropipetting, cell cultures, chromatography and bio-analytic chemistry."

PRACTICE MAKES PERFECT

by Jen Sprance

From a distance, it would be easy to mistake North Carolina's BioNetwork mobile laboratory for a city bus as it makes pit stops across the state's sprawling community college network. But take a look inside and there's no mistaking the fact that the educational experiment on wheels is one of the most unique and innovative workforce training initiatives in the state. It's also the only one of its kind in the country.

Launched in 2006 in part to solidify North Carolina's standing as a national biotech hub, the mobile laboratory is outfitted with life science workstations, specialized equipment, and, most important, experienced faculty. Now in its third year of operations, as North Carolina finds itself in the throes of an economic recession, the mobile laboratory is helping residents polish their laboratory skills so that the state's life science industry continues to thrive.

Serving students and industry

Educators have praised the mobile laboratory's mission to train a new generation of laboratory workers in North Carolina, and the laboratory is scoring points with the state's biotech industry as a model for improving the skills of the state's current and future laboratory workforce. In addition to traveling to nearly 60 college campuses, the laboratory also made stops at companies across the state, providing practical workshops and classes for laboratory workers in diverse industries. Most recently, the program has been refocused as The Mobile Launch Pad for Critical Careers, an outreach project designed to recruit middle and high school students into critical career pathways, including healthcare and the life sciences.

As part of its life science training program, the BioNetwork mobile laboratory conducts training in such areas as micropipetting, cell cultures, chromatography and bio-analytic chemistry. To date the laboratory has trained nearly 300 people in the state by providing hands-on practice on some of the most sophisticated laboratory equipment available. When it's not on the road, the laboratory is based at the Capstone Center at North Carolina State University's Centennial Campus in Raleigh, and hosted by Wake Technical Community College.

Instructor Lisa Richman runs the program and travels all across the state to conduct training workshops and classes. By providing instruction on proper laboratory techniques, she says, the program is able to serve the future needs of the industry by introducing life science training early in students' skills development. "By developing these programs," she adds, "we've created a connection between those in the industry and the next generation of workers who will be entering the field."

Improving pipetting precision and accuracy

With strained company budgets that limit worker training, it's beneficial to have employees enter the industry with basic skills in place. For this reason, one of the mobile lab's most important course offerings is on micropipetting, which Richman teaches in two-, four-, six-, or eight-hour sessions. Pipetting is one of the most important skills in the laboratory, and accurate liquid handling is critical for laboratory assay work. The importance of accurate pipetting has gained urgency in recent years as laboratories handle ever-smaller liquid volumes, thus increasing the margin of error.

▲ *Instructor Lisa Richman teaches proper pipetting technique aboard the BioNetwork mobile laboratory.*

"One of our goals is to improve pipetting skills so that we create a more uniform standard and reduce inaccuracy and imprecision as much as possible," Richman says. "If a company has a product failure, we want to make sure that worker performance in the laboratory is not a contributing factor."

Teaching proper pipetting technique can be elusive, but Richman has taken advantage of special equipment and training protocols provided by Westbrook, Maine-based ARTEL, a provider of pipette calibration technology. The mobile laboratory is outfitted with the ARTEL PCS® Pipette Calibration System that automatically verifies volumes dispensed from single channel pipettes and provides standardized test results.

PERSPECTIVE ON: A MOBILE TRAINING LAB

▲ *The Artel PCS® Pipette Calibration System provides students immediate feedback on proper pipetting techniques.*

"As a teaching tool, the PCS is important because it provides immediate feedback to the students by generating documentation showing their performance. Students can make adjustments to their technique as they learn, and then test their results with the PCS," Richman says. "It's enormously effective because students from the beginning level all the way through advanced can take advantage of it, regardless of skill level."

To add some competitive fun to the course, Richman gives students gold, silver, and bronze achievement stickers based on how accurately they dispense volumes with pipettes. The stickers also give students some bragging rights; after all, "they can show their documented improvement to their teachers, peers, and future managers," she adds.

"An additional component of the mobile lab's mission is community outreach."

Providing relevant, hands-on training

Another aim of the course is to reinforce the importance of ergonomics in the workplace. Laboratory workers often pipette for several hours a day, which can lead to repetitive strain injuries. Some ergonomic tips that Richman teaches include rotating pipetting tasks among several people, and avoiding excessive force (for instance, when putting on new tips, or when depressing the plunger) while using pipettes.

To prepare students for pipetting in the real world, Richman incorporates lessons using solutions with different colors and viscosities, to replicate the liquids used in actual laboratory situations. "We even tried a class using molasses," she says. "It turned out to be a bit of a mess, but the point is we wanted to customize the class to give the students the hands-on practice they need with a liquid that resembles plasma or albumin." She also uses common pipette brands in her lessons so that training mimics day-to-day usage in actual laboratories as much as possible.

When providing training for actual laboratory technicians, flexibility was a mantra for the mobile lab, and courses were routinely adjusted to meet the needs of a company, or even a specific department. One example is a recent training at a biopharmaceutical firm in the Research Triangle Park area. The mobile laboratory scheduled trainings to fit the company's round-the-clock operations. The first training began at 7:00 a.m. for workers just coming off the graveyard shift, and then classes held later in the day were programmed for workers just beginning their workday. Before they finished, mobile laboratory instructors had put in three shifts of training in one day.

Besides training, community outreach

Besides supporting science-based curriculum programs for community college students, an additional component of the mobile lab's mission is community outreach. When she's not teaching courses on various campuses or visiting company sites, Richman can often be found at community events throughout the state, helping to promote the life science industry to the general public.

"Part of my goal is to remove the mystery behind biotechnology and life sciences," she says, noting that community education is important because, for some people, the world of biotechnology is strange, or worse. "A lot of people find science a scary thing, and when they visit us they learn more about the fields they can go into, and they realize it's a viable career choice."

Recently the laboratory was parked at the North Carolina State Fair in Raleigh for 11 days, during which time some 2,600 people visited. Richman relates how one of her joys is watching parents who work in life sciences visit the laboratory and bring their children. "They like to show their kids what they do for a living, and that's fun to see."

Those moments, however, are peppered with the sober realities of the current economic situation of North Carolina, and of the nation. As the workforce in the state has been affected by the recession, it has been increasingly difficult to find new employment opportunities. By teaching young students critical industry skills, the mobile lab is helping them get a head start on future careers and making them attractive candidates for future positions.

"This program is all about workforce development," Richman says, noting that her recent experience dispels any myths of the biotech sector's presumed immunity from recession. On the contrary, the recession has served to reinforce the importance of the lab's educative mission. "This program is keeping us busy, but our goal is to keep North Carolina's scientific workforce among the best-trained in the nation."

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For more information about ARTEL, visit www.artel-usa.com.

THE
PITTSBURGH CONFERENCE
TECHNOLOGY GUIDE

PITTCON
CONFERENCE & EXPO 2010

CONTENTS

COLORING OUTSIDE THE LINES

CHANGING THE LAB MANAGEMENT RULES

by Jeffrey I. Tobe, CSP

Gone are the days when a lab manager—generally a former researcher— can just do scientifically correct work and get paid for it, no matter what. Today that manager must be aware of the business side of things and accept the fact that some research efforts may not go forward because of lack of funds. He or she must also focus more on efficiency while minimizing overhead and customer costs. In addition to getting projects completed on time with fewer resources, managers have the additional pressure of creating new products or processes that will help the company's bottom line.

Now more than ever, the greatest challenge facing the contemporary lab manager is not merely achieving a scientifically relevant result but also achieving one that is within budget, on schedule, and—most important—profitable.

Faced with these new challenges, today's lab managers can either stay where they are and tread water or else rethink their approaches to find new and more creative ways to run their labs.

"So, why not ignore the competition and begin recreating the way the 'lab management game' is played?"

Begin coloring outside the lines

To succeed in today's marketplace, lab managers need to be creative and innovative. Though many lab professionals don't see themselves as creative, in fact they ARE—each and every time they question the 'norm'.

Recently, I sat down to play a Chutes-and-Ladders-type game with my seven-year-old niece.

It was a lot of fun to see her little mind at work, but she had one annoying habit: she was continually bending the rules, reshaping roles, changing the boundaries, and reversing strategies. Everything I took for granted, she challenged. Cheating? I don't think so.

When we decide to compete within currently existing guidelines, we implicitly agree to play the game the way it has always been played, to abide by the formal and informal rules and roles as well as the prescribed methods and procedures. Although competing can be fun and exciting, it is not very creative and definitely limits the imagination. It is because of this experience that I have concluded that COMPETITION ENCOURAGES CONFORMITY.

Kids are always changing the rules and the way games are played. Research shows that kids spend more time creating and recreating games than actually playing them. So, why not ignore the competition and begin recreating the way the "lab management game" is played?

Whether you're trying to achieve greater productivity with fewer resources, gain market share from a competing lab, or improve efficiencies and delivery systems, innovative solutions will not be found if you simply keep up with or improve upon the way things have always been done. When you agree to play by the old rules—to color inside the lines—innovation can't happen.

I believe that there is no such thing as new ideas, only new ways of presenting old ideas. Once you make the decision to not look in your rearview mirror (to the past for established guidelines) but rather through your windshield to see what is coming down the road, you'll discover that you don't need to reinvent the wheel to be successful. Approach new challenges with the mind-set that you are going to find new ways to do what you are already doing. This may mean becoming more streamlined in your activities, becoming more focused on the deliverables of

the business, rethinking how you communicate with your staff, and/or paying closer attention to the business than the science.

"Competing will never deliver the breakthroughs you need to really move ahead of the pack."

When you engage in competition as a head-to-head battle, there are no real winners and you often lose any advantage you had in the marketplace. While facing your competitors head-on may deliver some small market advantages and the occasional "one up," competing will never deliver the breakthroughs you need to really move ahead of the pack. If you spend your time focusing on the way things have always been done in your lab, you are not prioritizing your energies correctly.

Start by asking yourself, "How can I present my product/service or my lab's expertise differently than it has been presented in the past?"

By changing the rules of the game, you get outside of your comfort zone and begin to look at your lab from a new perspective. You are not going to be comfortable any longer and you can either accept the challenge or get left behind.

Wayne Gretzky, one of the greatest hockey players of all time, was once asked by a reporter how he always managed to be where the puck was. After much thought, Gretzky replied, "I'm not always where the puck is. I am always where the puck is going to be!"

As a lab manager, do you want to be where your lab is today or where you would like it to be tomorrow?

Below are some practical tips to help you develop the skills and habits you need to "color outside the lines:"

- **Spark innovative thinking in yourself and others.**
  We tap into our creative being only when we start to question the norm. Internally and externally we simply need to ask the question "What if?" By asking this open-ended question we invite input and eventually get buy-in to our ideas.

COLORING OUTSIDE THE LINES

- **Redefine the challenges you face every day**.
  The most effective lab managers are able to look at any challenge from a different perspective. It requires the conviction that there is more than one right answer to any challenge. Mostly, we become complacent in our careers. We continue doing the things that are comfortable, and we do other things just because "that's the way we have always done them." When it becomes a conscious effort to redefine what we do every day by trying to find the "second right answer," we awake to the possibilities both in our personal and professional lives.

"How can I present my product/service or my lab's expertise differently than it has been presented in the past?"

- **Find motives for being more creative in your professional and personal life.**
  When lab professionals were asked, "Why be more creative?" most were afraid to answer; those who did mentioned "productivity" or "efficiency." Only one person whispered—at the risk of being laughed at—"fun." Wouldn't you agree that people want to work for, and work with, people who seem to enjoy what they do for a living? Having fun is the number one reason to be more creative. It's contagious! Secondly, we need to add more value to what we are asking our people to do in a do-more-with-less world. Being creative increases the value of the work in our peoples' minds versus the perceived cost of doing what you are asking them to do.
- **Develop techniques to effectively manage the change that comes with innovation.**
  We must get beyond managing change and look to how to thrive in it. We need to be change agents if we are to survive in today's laboratory. Many managers will say that their teams hate change. This really isn't true. You work in an ever-changing world. The outside world is changing all the time. People do not dislike change; they dislike the speed at which they are being asked to change.

"People do not dislike change; they dislike the speed at which they are being asked to change."

- **Tap into your creativity to challenge your existing boundaries.**
  Everyone is creative! That is the first thing you must accept if you are to tap into your innate creativity. When were we most creative? When we were kids. And that creativity is still there inside every one of us. Begin by changing the self-fulfilling prophecy of "I'm NOT creative."
- **See the world through your internal and external clients' filters.**
  We need to see the world through THEIR eyes. The key to creative thinking is perspective. Be willing to look at the challenge from THEIR perspective. This is a difficult thing. It might mean you need to give up

your preconceived notions; you might need to be flexible enough to change direction; and you might need to admit that there is another way to tackle the same challenge.

- **Give yourself an "alternative solution kick" when you think you have the right answer.**
  This goes back to believing that for every challenge our internal or external client brings us, there is always—ALWAYS—a second right answer. Historically, every creative idea—every innovative company—started because somebody dared to look for that alternative solution.

There is no better time than now to revamp your traditional belief system when it comes to managing your lab. I encourage you to stop looking in your rear view mirror to see how things were done in the past. Instead, look through your windshield to see what is coming down the road ahead and find creative ways to innovate, manage change, and create value for your lab.

Jeffrey Tobe *is the primary colorer at Coloring Outside the Lines™. He conducts change management workshops and delivers keynote speeches for diverse groups, companies, and associations worldwide. Jeff is the author of the book "Coloring Outside the Lines…Business Thoughts on Creativity, Sales and Marketing." To learn more about Jeff, visit www.JeffTobe.com.*

To register to attend Jeff's Coloring Outside the Lines: Innovation and Creative Problem Solving workshop at this year's *Lab Manager Magazine* Pittcon Boot Camp (Wednesday afternoon, March 3, in the Orlando Convention Center), visit www.labmanagerbootcamp.com.

EVOLUTION OF THE PITTSBURGH CONFERENCE

by Katia Caporiccio

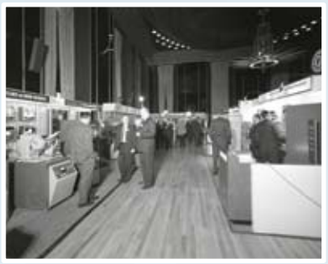
After war broke out in Europe in 1939, the demand for quality goods and supplies skyrocketed. Mary Warga, an emissions spectroscopist and physics professor at the University of Pittsburgh, became heavily involved in the war effort and started organizing small meetings on applied spectroscopy that gave rise to what is known today as the Pittsburgh Conference. Meeting attendance grew, and by 1946 the Spectroscopy Society of Pittsburgh (SSP) was born. With Warga as its chairperson, the SSP held its first annual Pittsburgh Conference on Applied Spectroscopy.

The SSP joined the Society for Analytical Chemists of Pittsburgh (SACP) and in February 1950, the first Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy was held on the 17th floor of the William Penn Hotel in downtown Pittsburgh.

1950 (Pittsburgh) – The three-day conference attracted 800 attendees at an admission price of $2 each. Prominent researchers in analytical chemistry included Van Zandt Williams, head of infrared spectroscopy at PerkinElmer, and Arnold Orville Beckman, inventor of the pH meter and founder of Beckman Instruments, which in 1998 became Beckman Coulter.

1957 (Pittsburgh) – The number of attendees had grown steadily over the first few years of the conference, as new technologies emerged. Automation was a popular catchphrase in 1957, with automatic recording being applied to burettes for titrimetry, vacuum microbalances, flow colorimeters and turbidimeters.

1960 (Pittsburgh)



1967 (Pittsburgh) – Every space within a fifty-mile radius of the Penn-Sheraton Hotel was filled to capacity. Debates started to emerge over whether to move to another city and grow even larger, or stay in Pittsburgh and limit the show's growth.

1968 (Cleveland) — In October 1967, the Penn-Sheraton Hotel workers went on strike, so the Pittsburgh Conference organizers scrambled to find space for exhibits and housing for attendees. There were no other venues in Pittsburgh that could meet the needs of the ever-expanding conference, and the strike showed no signs of a resolution. The Cleveland Convention Center was available the first week of March, so the show was moved to Ohio. The committee members did not immediately abandon the idea of one day returning to Pittsburgh, but to this day the Conference has not seen its hometown.

1978 (Cleveland) –This was the first year that a woman, Jane Judd, served as exhibition president. Attendance numbers continued to soar. The 13,489 attendees at the 29th conference took in symposia on glass capillary gas chromatography, lab automation, microcomputers, OSHA and industrial hygiene, FT-IR and liquid chromatography on coal liquefication products.

1980 (Atlantic City) – When the staff at the Cleveland Convention Center scheduled a flower show the same week as the 31st Pittsburgh Conference, they damaged their relationship with the Pittsburgh organizers. Even the offer of free shuttle service and the construction of customized seminar rooms if they would stay one more year was not enough to bring the volunteers back to Cleveland. The conference moved to Atlantic City, New Jersey.

1984 (Atlantic City) – The theme for the 35th Pittsburgh Conference was "Instrumentation of the Future and an Overview of the Pimentel Report: New Frontiers in Chemistry." More than a thousand people attended the central presentation by George C. Pimentel. "The Practice of Capillary Column Gas Chromatography I, II and III" highlighted this successful analytical technique.

1985 (New Orleans) – Arnold Beckman was honored at the 1985 Pittsburgh Conference on the 50th anniversary of the founding of his company, Beckman Instruments. The scope of the Conference had been increasing progressively since its inception in 1950, and it now ranked as one of the top technical meetings and trade shows in the country, if not the world. Its net worth was documented to be in the millions of dollars.

1989 (Atlanta) – Short course topics now included chromatography, electrophoresis, mass spectrometry, ICP-mass spectrometry, near infrared and supercritical fluid chromatography, among others. Rich Danchik, volunteer and president of the 37th Conference in 1986, credits PerkinElmer with a major technological advancement. "In the late 80s we had the first LIMS system from PerkinElmer," he said. "It really changed the way things worked." Ann Puskaric, president of the 41st Conference in 1990, agreed that LIMS was a breakthrough. "I tell people how I used to acquire data and they look at me like I'm an antique!" she said.

1990 (New York City) – A new symposium was introduced in 1990: the James L. Waters Annual Symposium Recognizing Pioneers in the Development of Analytical Instrumentation, which focused on gas chromatography. Even before the 1990 Conference opened, the show's requirements were greater than what the available facilities could provide. There weren't enough program and seminar rooms, and many of the conference programs and expositions spilled out into the halls, so the show was forced to move again.

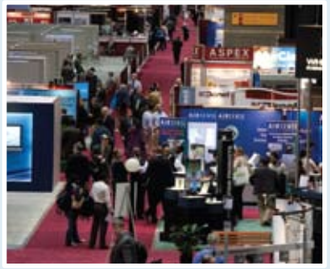
1992 (New Orleans) – The name "Pittcon" was finally trademarked, after it had been used as a nickname by conferees and exhibitors since the early 1970s. The 3rd James L. Waters Annual Symposium focused on infrared spectroscopy. Among the speakers at the Waters Symposium was Paul L. Wilks, who built PerkinElmer's first commercial infrared instrument in 1944.

1993 (Atlanta) – With continued popularity, The James L. Waters Symposium honored four pioneers in nuclear magnetic resonance. Ed Ladner, chairman of activities, remembered the "fun runs" Bio-Rad had sponsored for several years in Atlantic City and used the idea to host something similar—the "First Annual Pittsburgh Conference 50-Trillion-Angstrom (5k) Run."

1995 (New Orleans) – The 6th Waters Symposium focused on high performance liquid chromatography after James L. Waters turned his company, Waters Associates, into an HPLC company.

2001 (New Orleans) – The technical program consisted of 215 sessions, including 50 symposia which focused on various topics: bioanalytical and electroanalytical chemistry, spectroscopy, mass spectroscopy, computers, laboratory information management systems, chromatography and capillary electrophoresis, microscopy and general difficulties with analytical chemistry. Much attention was given to LIMS.

2009 (Chicago) – In the face of a global economic recession, many exhibitors focused on customer needs and amplified workflow in order to remain competitive by offering rapid return on investment. Hot topics at the show were near-infrared spectroscopy, nanotechnology, genomics, chemical imaging, informatics, ELNs and LIMS. Attendance fell just below the 20,000 mark in 2008 and 2009, most likely due to budget constraints caused by the recession, but the number of exhibitors and papers continues to rise.



Future: One of the biggest challenges facing Pittcon is the change in the way information is exchanged. With so much information available on the Internet, and the surge of online communication tools such as webcasts and virtual meetings, product literature and vendor information can be accessed without traveling to an annual exhibition. However, online tools can also compel companies to come up with new ways to interact with their customers.

"One-on-one communication is still important," said Rich Danchik, who's been a Pittcon volunteer for more than 40 years. "You can only get so much from statistics on a [web]site."

Looking to Pittcon 2010, Danchik has a positive outlook. "We understand the economy isn't the greatest right now," he said. "We're hoping for the best and encouraging people to come."

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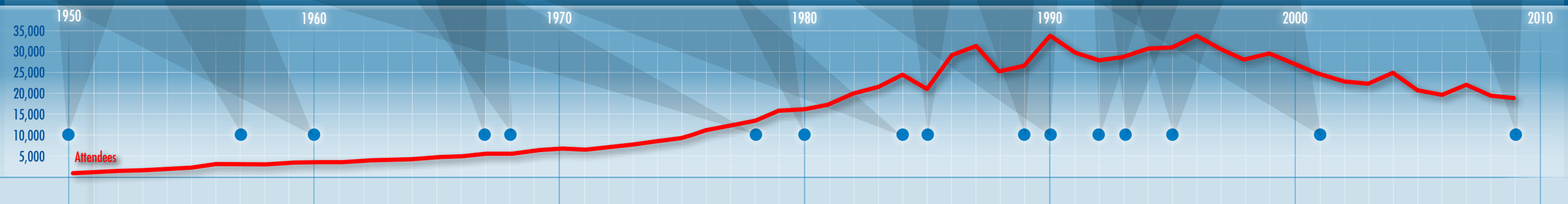

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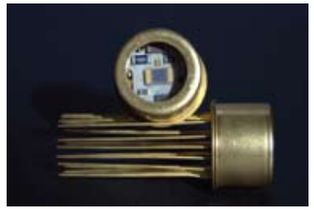

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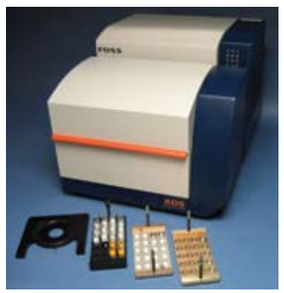

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"Shaking Things Up" does not require a "Shake Down"

The LAB COMPANION SI-600R temperature controlled shaker from JEIO TECH shows that "Shaking Things Up" does not require a "Shake Down" of your laboratory budget!
The SI-600R from Lab Companion combines a Benchtop Refrigerated Incubator with a Dual-Action Orbital and Reciprocating Shaker. This versatile unit fulfills a variety of molecular biology, general incubation, and cell culture applications. Selectable between orbital or reciprocating action, the speed range is from 10 to 300 rpm. The SI-600R can be programmed for a Run Time from 10 Seconds to 999 Hours with Forward-Backward-Pause cycles. The temperature range is 15° C to 60° C with uniformity of ±1.0° C at 38° C. The temperature can be programmed in steps/segments and cycles. An RS-232 serial port is standard along with "Lab Tracer" communication software. The platform is 16.1" x 16.1" with the ability to hold up to five 2 liter Erlenmeyer flasks. It can be equipped with a wide range of clamps, racks and other accessories.

The SI-600R is one of seven benchtop shakers from Lab Companion (five models shown above) for mid- to high-capacity shaking needs. There are four temperature control shakers: the SI-300, SI-300R, SI-600, and SI-600R. There are three open-air shakers: the SK-300, SK-600, and SK-71. In addition for very large capacity needs, we offer three floor type temperature controlled shakers: the IS-971, IS-971R, and IS-971RF.

SHAKING POINTS: Robust Construction

- All Lab Companion Shakers offer a solid constructed chassis and drive system for heavy shaking loads
- All Lab Companion Shakers offer a quiet long-lasting brushless DC motor for maintenance-free operation
- All Lab Companion Shakers offer a spill guard—keeping critical electronics safe from spillage from broken flasks, bottles and tubes
- All Lab Companion Shakers are engineered to perform in a wide range of operating environments

Shaking Motion

- All Lab Companion Shakers offer dual motion action – Orbital and Reciprocal movement
- All Lab Companion Shakers can be programmed to move in a forward or reverse orbital direction with a pause and restart option available
- All Lab Companion Shakers offer a speed range of 10 to 300 rpms
- All Lab Companion Shakers offer run times from 10 seconds to 999 hours
- All Lab Companion Shakers offer a wide range of different stroke diameter settings

Operating Controls

- All Lab Companion Temperature Controlled Shakers offer microprocessor PID control with Auto-Tuning and Calibration of temperature
- All Lab Companion Temperature Controlled Shakers offer a delayed time setting (Wait On – Wait Off) of shaking motion until set temperature is reached
- All Lab Companion Temperature Controlled Shakers offer memory slots for three temperature settings
- All Lab Companion Temperature Controlled Shakers offer step programming of temperature (9 steps and 200 cycles)
- All Lab Companion Temperature Controlled Shakers offer RS-232 serial ports and free "Lab Tracer" communication software for GLP and GMP documentation
- All Lab Companion Temperature Controlled Shakers offer a high velocity fan with three speed settings for fast thermal recovery and excellent temperature uniformity
- All Lab Companion Temperature Controlled Shakers offer "Over Temperature" safety settings and automatic restart in case of power failures

Accessories

- Universal Platforms
- A Wide Range of Flask Clamps (125ml to 6 liters)
- Tube Racks and Spring Wire Attachments
- Many other types of holders for a variety of needs

Jeio Tech products are engineered and sold under the brand name Lab Companion. They represent our company's commitment to customer satisfaction. Please consider us for your other laboratory needs for Incubators, Baths, Ovens, Stirrers, Test Chambers, and much more at www.jeiotech.com

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- *Detects smallest gas leaks (<1 ml/min); leaks are indicated by a LED light and an alarm*
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PRODUCT SPOTLIGHT BOOTH 2731

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COMBINES ATMOSPHERIC SCANNING ELECTRON MICROSCOPE WITH LIGHT MICROSCOPE

JEOL's new ClairScope™ enables uncompromised observation of samples in their native state using a light microscope (LM) and an atmospheric scanning electron microscope (ASEM) to significantly reduce sample prep time and allow dynamic observation of real time processes.

The wide-field light microscope with emersion lens is co-axially aligned with the inverted electron column, making it easy to switch between LM and ASEM without moving the specimen dish. Samples can be observed dynamically at room temperature and at atmosphere, without having to wait for drying processes.

The specimen dish features an ultrathin SiN (silicon nitride) film window that separates the sample in atmosphere from the vacuum in the ASEM. An electron beam is projected from below to the sample on the film for high resolution imaging of the sample in atmosphere. The dish also makes it possible to add reagents, drugs and other substances to the sample in order to observe reactions in both liquid and gas environments.

Ideal for the life science and materials industries, dynamic processes such as platelet generation, microbe growth, crystallization, electrochemical reactions and dendrite growth can be followed in real time. No other products, add-ons or consumables are required, other than the sample holders.

For more information, visit www.jeolusa.com or visit booth 2731 at Pittcon 2010 in Orlando, Florida. Donna Guarrera, assistant director SM Division at JEOL, can be reached at dguarrera@jeol.com, or by phone at 978-535-5900.

Sievers InnovOx On-Line TOC Analyzer

Booth 3645

- Able to handle tough samples like brine and discharge water, with minimal maintenance
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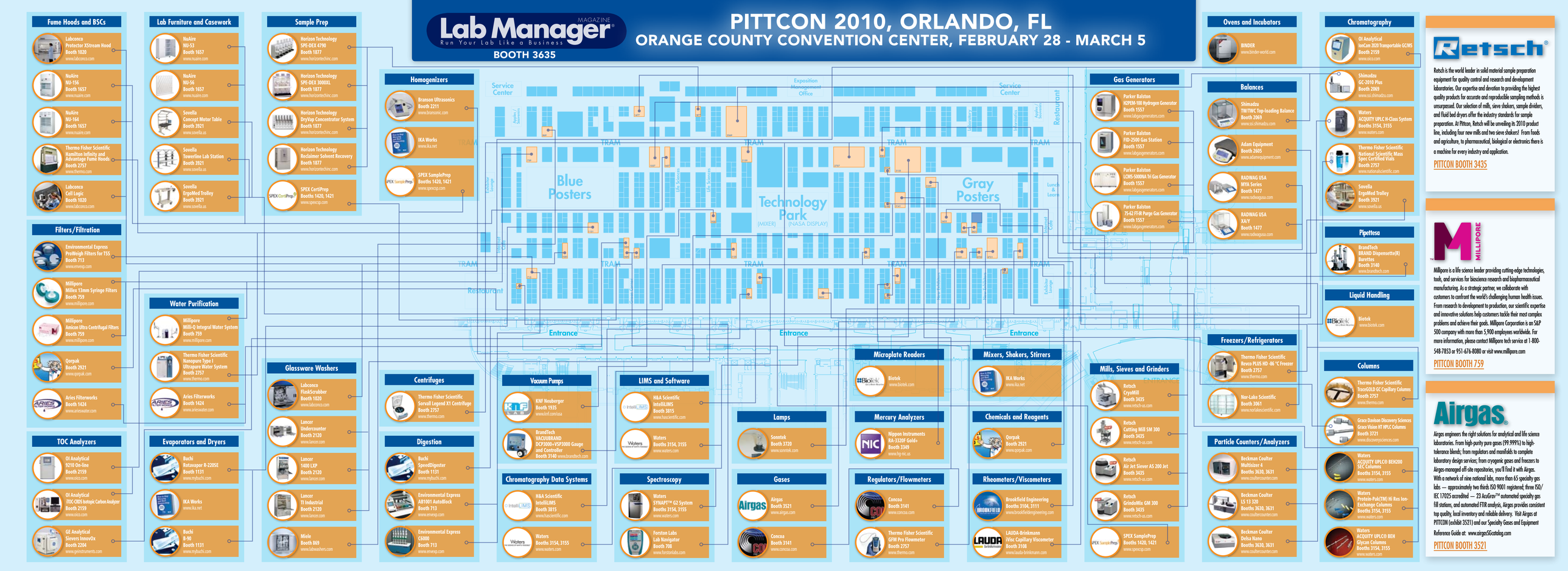
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GC-2010 Plus Capillary Gas Chromatograph

Booth 2069

- Employs Advanced Flow Technology, a redesigned suite of detectors with heightened sensitivity and fast heating and cooling
- Features a backflush system to prevent column deterioration and detector contamination
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GFM Pro Flowmeter

Booth 2757

- Capable of measuring both positive and negative vacuum flows from 0.5 to 500 ml/min and -0.5 to -500 ml/min
- Measures the volumetric flow of any gas with an accuracy of ± 2%
- Unit deploys an automatic shut-off when the measured flow exceeds 600 ml/min
- Ideal for use with any gas, even those that are flammable or explosive

Thermo Fisher Scientific
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GUARDION®-7 GC-TMS

Booth 735

- Now available with rechargeable batteries that last up to 6 hours
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- Features an on-board helium carrier gas cartridge
- Electronic pressure control (EPC) of helium carrier gas provides rapid separation of analytes in less than 3 minutes

Torion www.torion.com

Mobile Perfluoronated Tracer (PFT) Analyzer

Booth 2252

- For the analysis of feeder oil leaks in high voltage feeder lines
- Uses dual ambient sorbent trabs to trap and desorb an ambient air sample to a GC every 90 seconds
- Sampling is fully automated by Wasson-ECE's control software
- When the system detects a PFT leak, an alarm is sounded and the leak is marked on a GPS map

Wasson-ECE www.wasson-ece.com

SYNAPT™ G2 Quadrupole Time-of-Flight Mass Spectrometer

Booth 3155

- Features a data acquisition rate of 20 spectra per second
- Employs QuanTof Technology, to ensure exact mass data in UPLC® timeframes
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The new Axio Imager 2 microscope from Carl Zeiss promotes maximum flexibility and ease of use. The customizable options of the ten stand versions make it easy to achieve optimal performance and functionality. The light manager can store and reproduce the illumination intensities for each magnification, while the motorized stands allow one to select stored contrasting techniques via the contrast manager.

The microscope's multi-user capabilities can store vital system parameters for up to ten users, making it simple for everyone in the lab to have their settings readily available to them. The Z-stand features a high-performance focus drive, with which a user can perform even the smallest focus movements.

The Axio Imager 2 features a new optical design for the transmitted light beam path and the condensers, permitting homogenous illumination at low magnifications and an even greater working distance. Two added functions are the ability to automatically switch between reflected and transmitted light and the generation of mixed light, for areas of research involving living cells or organic tissue.

The AxioVision software automatically stores important magnification, contrast and illumination data. The triggerable LED light source for Köhler illumination, integrated with the z-piezo insert, offers rapid acquisition of Z-stacks or high resolution overview images.

For more information, visit www.zeiss.com/micro or visit booths 4051 and 3951 at Pittcon 2010 in Orlando, Florida. Kristen Orlowski, Product Marketing Manager, Light Microscopy, can be reached at korlowski@zeiss.com, or by phone at 860-316-7648.

BASIC LAB

Independence™ Ductless Fume Hood

Booth 2741

- Silconazyne™ allows for one gas phase filter that fits most gas phase applications
- On-board chemical database features more than 1,000 approved chemicals
- Includes a built-in gas analyzer that produces absolute exhaust and Interfilter™ values
- Includes AirClean® Operating System, written entirely by AirClean® Systems

AirClean Systems
www.aircleansystems.com

Purair Advanced Ductless Fume Hoods

Booth 3913

- Face velocity at 100 fpm ensures containment of fumes
- An alarm will alert the operator when the airflow falls to an unacceptable level
- The work area features a removable spillage tray which can be easily cleaned
- Main filter can be chosen from 14 different types of carbon

Air Science www.air-science.com

Powder Flow Tester

Booth 3111

- Minimizes the downtime and expense that occur when hoppers/silos fail to discharge
- Features various test options, such as Flow Function, Wall Friction and Bulk Density
- Choice of Flow Function tests: Demo, Standard or High Precision
- Compact, vertical design with small footprint fits easily on workbench

Brookfield Engineering www.brookfieldengineering.com

Nano Spray Dryer B-90

Booth 1131

- Heater technology is based on porous metal foam for laminar gas flow in drying chamber
- Optimal energy input guarantees fast heating times up to 120°C
- Dried particles are separated by an electrostatic particle collector
- Produces submicron or nanoparticles from 300 nm to 5 µm with narrow distribution

Buchi Corporation
www.mybuchi.com

PRODUCT SPOTLIGHT

CYLINDER-BASED MICROARRAY TECHNOLOGY

DISCOVER INTRICATE OFF-RATE MEASUREMENT WITH HYBCELL TECHNOLOGY

Hybcell is the first DNA or protein microarray based on the use of cylinders instead of slides. These cylindrical microarrays yield robust hybridization and reproducible results by rotational sample agitation.

The hybcells are robotically processed by the hyborg—a fully automated, compact device that can hold up to 96 hybcells at a time. Hyborg integrates thermocycler, hybridization station and scanner all in one unit. Temperatures, buffers and multiple scans are freely configurable, providing the greatest flexibility and kinetic analysis.

In typical microbiology, where it can take 48 hours for a sample to produce results, hybcell technology provides results within ten minutes for a multiplexed ELISA, up to two hours for a compact sequencing application, all while delivering hundreds of results for a single sample (presence of bacteria, viruses, genes, antibodies, etc).

Hybcell technology offers selectivity (elimination of unspecific binding effects), measurement of binding kinetics, assay versatility, fully automated assay operation and minimum user intervention.

Hybcells can be filled by either a pipette or automated robot. Each sample is then linked to a unique bar code. Once the hybcells are transferred to the hyborg, all further processes are automated, reducing the risk of user errors.

For more information, visit www.anagnostics.com. CEO Christoph Reschreiter can be reached at c.reschreiter@anagnostics.com, or by phone at +43 7252 58193-0.

Nitrogen Generators NitroVap-1LV and NitroVap-2LV

Booth 1557

- Produce more than 320 LPM of pure evaporation-grade nitrogen
- Require less than 1 square foot of bench space and can supply more than 100 evaporator nozzle positions
- Use a combination of filtration and membrane separation technologies
- High-efficiency coalescing filters remove all contaminants down to 0.01 micron

Parker Balston www.labgasgenerators.com

Continuous Roll Microplate Heat Sealer TriSeal Pro

- Includes a 610 meter film roll, enabling up to 5,000 plates to be sealed without intervention
- Features a turntable design, which allows simultaneous loading, unloading and sealing
- Capable of sealing three plates per minute
- Features adjustable temperature control from 50°C to 185°C

Porvair Sciences www.porvair-sciences.com

Traceable® Conductivity/ TDS/Salinity Meter

Booth 3331

- Elimination of operator technique lets everyone in the lab report identical readings
- Features instant-response probe and solid-state thermistor for precise readings
- Dual display shows reading and temperature
- Features a tough, chemical-resistant, waterproof ABS housing

Control Company www.control3.com

ANALYSETTE 22 Micro Tec Plus Laser Particle Sizer

Booth 1829

- Features extra-wide measuring range of 0.08 – 2,000 µm
- Employs dual-laser technology
- Wet dispersion unit includes a centrifugal pump for transporting even heavy particles
- Measuring cells come in convenient cartridges

Fritsch www.fritsch.de/en

PULVERISETTE 6 Planetary Ball Mill Premium Line

Booth 1829

- Features automatic imbalance compensation and a grinding bowl lock system
- Able to grind larger sample quantities down into the nano range
- Includes a special emptying device with 2 sieves for grinding bowls
- EASY GTM ensures the set grinding parameters are not exceeded

Fritsch
www.fritsch.de/en

Specialty Gas Control Panel P3500 Series

Booth 2846

- Provides continuous gas supply without interrupting the system during cylinder replacement
- When primary bank is nearly empty, the reserve bank will automatically supply gas to the system
- Each regulator is mounted on individual panels for in-line repair
- Available in either stainless steel or brass; single- or dual-stage configurations

Genstar Technologies www.genstartech.com

DIG DEEPER

This month's "Dig Deeper" video features Jeffrey Tobe, author of the feature article "Coloring Outside the Lines" on page 68. Picking up where the article leaves off, Tobe answers questions about the origins of the "Coloring Outside the Lines" concept and how to inspire those managers who, by training and/or temperament, might be reluctant to challenge traditional management methods. He also discusses the need to acknowledge one's own creativity in order to get one's staff to unleash their creativity as well. To see the complete video interview with Jeffrey Tobe, visit www.qorpak.com/labmanager.

To register to attend Jeff's Coloring Outside the Lines: Innovation and Creative Problem Solving workshop at this year's Lab Manager Magazine Pittcon Boot Camp (Wednesday afternoon, March 3, in the Orlando Convention Center), visit www.labmanagerbootcamp.com.

Look for more "Dig Deeper" video links in upcoming issues of *Lab Manager Magazine*. This new online feature is designed to offer a more in-depth exploration of the ideas behind particular articles and unique information that only the authors and "experts" themselves can provide.

U-Series Nebulizers for ICP

Booth 3171

- Sample channel is uniform from entry point to tip to prevent blockages
- VitriCone construction, with heavy glass capillary, resists vibration
- UniFit sample connector provides a simple connection with no dead volume
- Compatible with all ICP-OES and ICP-MS models

Glass Expansion www.geicp.com

ZEUS Pipetting Module for IVD Instruments

Booth 1669

- Aspirates volumes from 1 µL to 1,000 µL
- Ideal for any IVD instrument requiring on-board pipetting
- Qualitative Pipette Monitoring (QPM) automatically detects, reports and handles pipetting errors according to user-defined procedures

Hamilton Company
www.hamiltoncompany.com

Micron Air Jet Sieve

Booth 1641

- Employs the pneumatic sieving principle for enhanced accuracy and reproducibility of particle size analysis
- Able to quickly and accurately identify particles ranging from 20 to 4,750 microns
- Rotating wand eliminates the need for tapping
- Features a vacuum system for strong, quiet performance

Hosokawa Micron Powder Systems www.hmicronpowder.com

Presto® PLUS Series Temperature Control System

Booth 2747

- Combines rapid heat-up and cool-down times with wide working temperature ranges
- Bath fluids can be used with an extended temperature range and a long lifetime
- Features increased heating capacity, adjustable fluid flow and stability to ±0.01°C
- Includes splash-proof keypad

Julabo USA
www.julabo.com

FlexStream™ Modular Gas Standards Generator

Booth 1650

- Offers total flexibility for creating precision gas mixtures
- Features up to six independently controlled channels
- Can be controlled remotely by a PC or process computer using Modbus® connectivity
- Features an internal microprocessor to set the operating mode and adjust dilution flow

KIN-TEK Laboratories www.kin-tek.com

Purifier® Cell Logic® Biosafety Cabinets

Booth 1020

- Scope-Ready™ feature allows a customer-supplied microscope to be integrated into the cabinet
- Pure-Vu™ Seal allows a clear view into the cabinet
- Features a Stand-Still Isolation Platform which reduces vibration up to 300%
- Temp-Zone™ option keeps heated or chilled samples at their ideal temperatures

Labconco
www.labconco.com

PRODUCT SPOTLIGHT BOOTH 1935

LIQUID DOSING MADE SIMPLE

TRANSFER CORROSIVE LIQUIDS WITHOUT HAVING TO MEASURE AND POUR

KNF Neuberger designed its new SIMDOS® diaphragm liquid dosing pump with simplicity and ease in mind. Ideally suited for transferring corrosive liquids in the lab, the pump is available with a variety of wetted materials, including PTFE/FFPM.

The SIMDOS pump achieves fast, precise calibration within a short amount of time, transferring liquids at a flow rate of 0 to 100 ml per minute. Offering consistent reliability throughout entire processes, SIMDOS makes programming and access of all functions simple and intuitive.

Safety is a definite concern, with the pump head located outside the splash-protected IP-65 housing. The pump is safe to run dry and is self-priming in up to 9 feet of water. It can handle pressures of up to 90 psig and can transfer viscous media up to 150 centistokes.

Roland Anderson, laboratory product manager at KNF Neuberger, says SIMDOS has many benefits over conventional pumps. "Most people use a peristaltic pump," he said. "When you factor in the bending and aging of the tubing, performance starts to vary over time. The [SIMDOS] doesn't use any tubing, and it gives consistent results throughout its life."

The pump's electronic display, combined with a touch control knob, makes accessing all of its functions very simple. "It's designed so it's plug and play," Anderson added. "You can plug it in… walk away, and have it dose in the way you programmed it."

For more information, visit www.knf.com/labnew.htm or visit booth 1935 at Pittcon 2010 in Orlando, Florida. Roland Anderson, Laboratory Product Manager, can be reached at randerson@knf.com or by phone at 609-890-8600 ext. 241.

852 Titrando

Booth 1121

- Automatically recognizes sample additions
- Features fully automatic reagent exchange
- Bromine index can be determined
- Dosino® dosing technology eliminates build-up of air bubbles

Metrohm USA
www.metrohmusa.com

G7893 Glassware Washer

Booth 869

- A complete washing and drying cycle takes one hour
- Saves space with a 24-inch footprint
- Incorporates true HEPA-filtered forced-air drying
- A cool-down step can be programmed at the end of cycle to ensure glassware is safe to handle

Miele
www.labwasher.com

PG8527 Glassware Washer

Booth 869

- Cleans hundreds of pieces of glassware, using minimal water, detergent and electricity
- Features gentle start pumps so small items can be safely cleaned
- Features split-level cleaning so tall and short items can be cleaned in one wash load
- Includes a maintenance-free conductivity monitor and a self-draining wash chamber

Miele www.labwasher.com

Q-POD® Element Unit

Booth 1769

- Ensures delivery of ultrapure water with very low levels of elemental contamination
- Features a footswitch for hands-free water delivery
- Ideal for use in a Class 1000 clean room environment
- Supplies water in volumes required by the user (up to 1.5 L/min)

Millipore
www.millipore.com

PITTCON BOOTH 3435

PRODUCTS IN ACTION

Retsch Cutting Mill SM 300 for Sample Preparation of Tough Materials

Succeed where other cutting mills fail, with the newest product innovation from Retsch. The heavy-duty cutting mill SM 300 is designed to grind solid samples finer and faster than competitive mills, even Retsch's own SM 2000! Typical cutting mills are intended for preliminary/coarse size reduction of bulk materials like wood, bone, plastics and electronic waste, but the SM 300 has the ability to grind samples to a final fineness of < 0.25 mm.

▲ *Left to right: rubber soles, wood, electronic scrap*

The SM 300 boasts a powerful, high torque 3 kW (4.02 horsepower) motor for rapid preliminary and fine particle size reduction of heterogeneous mixtures such as organic waste, plastics, electronic components, rubber, wood and bones. Desired analytical fineness is often achieved in one working run. The sample material is only moderately warmed during the grinding process, so the SM 300 is also suitable for grinding temperature-sensitive materials. Another innovation is the variable speed motor from 700 to 3,000 min-1. Its fold-back housing and removable, push-fit rotor allow for quick and easy cleaning. In combination with the wide selection of bottom sieves, hoppers and collecting containers, the mill can be easily adapted for a large variety of applications.

For applications such as rubber or leather, conventional cutting mills require the sample be pre-embrittled with liquid nitrogen or dry ice; this is not the case with the SM 300. Entire shoe soles can be ground to < 5 mm in one run without pre-embrittlement!

In one lab test, wood chips (with a 10% moisture content) ranging from 1 – 70 mm in length were milled to < 750 micron in one pass (with a rate of ~13kg/hour). These results would take two, sometimes three passes in other cutting mills. Using a speed setting of 3,000 RPM and parallel section rotor, the heterogeneous mixture easily passed through a 1.0 mm bottom sieve.

Electronic components, such as processors and memory, can be reduced to ~1 mm in two simple steps. Pre-grinding would take place with the use of a 6-disc rotor (at a low revolution speed), then fine grinding at a high speed with a parallel section rotor. This application would typically require the use of two different mills, but thanks to the SM 300's powerful and variable speed motor, time and money is saved.

SM 300 Features & Advantages:

- Powerful, high torque 3 kW (4.02 horsepower) motor
- Variable speed rotor (700 – 3,000 min-1) allowing both preliminary and fine grinding
- Fast and easy cleaning with its fold-back housing and push-fit rotor. No tools required!
- Optimum results due to double action cutting bars
- Ergonomic design
- Wide range of accessories for any application

▲ *Heavy-duty cutting mill SM 300*

Retsch®

Retsch, Inc
74 Walker Ln Newtown, PA 18940
866-473-8724
www.retsch-us.com

Centrifan™ Recirculating Evaporator

Booth 3109

- Dramatically accelerates the evaporation of aqueous and organic solvents
- Operates without a vacuum pump, to prevent sample bumping or cross contamination
- Eliminates oil cleanups, heat, noise and tubing typically associated with a vacuum pump
- Available with various rotor configurations

Modular SFC www.modularsfc.com

Wood Casework

Booth 3334

- Each cabinet is made to order
- Cabinets are solid and offered in a unique full top frame
- Drawers are fully dovetailed in all corners and finished with the same flat line finish as the rest of the cabinets
- LEED projects are welcomed and encouraged

Mott Manufacturing www.mott.ca

Balston H2PEM Series Hydrogen Generators

Booths 1451 and 1557

- Produce over 510 cc/minute of 99.9995% pure hydrogen
- Features a unique water hydration circulation system
- Allow GC users to supply, control and automate all hydrogen gas supplies
- A single generator can support as many as 20 instruments with fuel gas

Parker Hannafin www.parker.com

LCMS-SF5000NA Super Flow TriGas Generator

Booths 1451 and 1557

- Produces gas which exceeds the requirements of any LC/MS requiring 3 independent gases
- Includes self regenerating compressed air dehydration membranes
- Provides enough gas for a single LC/MS instrument on a continual basis
- Eliminates the need for expensive, high pressure nitrogen and zero air cylinders

Parker Hannafin
www.parker.com

ABN2ZA Nitrogen Generator

Booth 3469

- Combines two separate gas generator systems in one unit
- Removes oxygen, moisture and other gases to leave clean, dry, phthalate-free nitrogen and air
- Fitted casters allow the user to easily position the unit in the lab
- No external compressor required

Peak Scientific
www.peakscientific.com

LaboStar™ Water Purification System

Booth 1111

- Produces analytical grade water on demand
- Features easy push-button operation and quick sanitization regimens
- Recirculation feature maintains optimal water quality while minimizing bacterial growth
- Produces up to 18 megohm ASTM water quality

Siemens Water Technologies
www.siemens.com

Compod™ Programmable Control Module

Booth 1634

- Permits networking of multiple instruments using open-source MODBUS RTU protocol
- Monitors the functionality of mass flow meters or controllers
- Controls simple processes without the need for external PLCs or computers
- Monitors the operation of instruments and provides potential problem alerts

Sierra Instruments www.sierrainstruments.com

STRIKE300 Rotary Evaporator

Booth 3502

- Transparent shield protects the user and working environment from moving parts
- Can be connected to a vacuum controller and/or temperature controller
- Includes an LCD interface and touch screen
- Mechanical sealing system guarantees a constant vacuum-tight seal

Steroglass www.steroglass.it

ColonyDoc-It Imaging Station

Booth 2220

- Lets users quickly and accurately count colonies with quick click software interface
- Features multiple excitation sources to visualize white light and fluorescent colonies
- High-resolution digital color camera identifies even the smallest colonies
- Accommodates plate and filter sizes from 33 mm to 150 mm

UVP www.uvp.com

LIFE SCIENCE

ChiralRAMAN-2X™ ROA Spectrometer

Booth 1841

- Combines Raman microscopy, Raman spectroscopy and Raman optical activity in one instrument
- Applications include structural characterisation of chiral molecules and biologicals such as proteins, sugars and viruses, as well as SERS and SEROA experiments

BioTools
www.btools.com

PRODUCT SPOTLIGHT BOOTH 2072

LASER PARTICLE SIZE ANALYZER

TRI-LASER DESIGN ENSURES ACCURACY ACROSS ENTIRE MEASUREMENT RANGE

The 1190 Particle Size Analyzer from Cilas Particle Size integrates three lasers to provide accuracy and precision from 0.04 to 2,500 microns. Measurements can be made in either liquid or dry dispersion modes and switching modes can be done with a single click of the mouse. The fully programmable dispersion system eliminates the need for the user to change hardware and it can switch between modes without having to be realigned. All optical components are mounted on a rigid cast iron base plate to ensure that the system is always aligned.

The integration of a CCD camera offers users the ability to measure an extended range of samples while maintaining a short bench design, providing for a more rugged tool. This concept allows the measurement range to be extended without increasing the size of the instrument.

Cilas' ExpertShape Image Analysis software allows for the measurement of shape parameters such as aspect ratio, perimeter, area, shape factor and fiber length. The 1190 also includes a free fall module for users who want to analyze their samples in their naturally agglomerated state.

For more information, visit www.particle-size.com. Product Manager Richard Nameth can be reached at richard@particle-size.com or by phone at 608-274-7719. Cilas Particle Size will be at Pittcon 2010 in Orlando, Florida at booth 2072.

Cell Imager

Booth 1669

- Accurately measures cell confluence and growth in 96-well plates
- Reads an entire 96-well plate in about 5 minutes
- Two positions allow one plate to be imaged while another is processed
- Software provides live data tracking for an overview of cell confluence in all plate wells

Hamilton Robotics
www.hamiltonrobotics.com

F-2700 Fluorescence Spectrophotometer

Booth 2041

- Available in two configurations: stand-alone or PC-controlled
- Features a signal-to-noise ratio of 800 S/N RMS (Raman band of water at 5 nm bandwidth)
- With PC control the scan speed can reach 12,000 nm/min
- Available accessories include automatic sampling and quantum yield measurement

Hitachi High Technologies America
www.hitachi-hta.com

2-D Omni Spray® Ion Source

Booth 1335

- Based on Desorption Electrospray Ionization (DESI)
- Features an automated surface platform to enable rapid sampling and surface imaging
- Can handle samples up to 76 mm by 114 mm (about the size of a 96-well plate)
- Capable of analyzing 96 sample spots in less than 10 minutes

Prosolia www.prosolia.com

SR7000DC Surface Plasmon Resonance (SPR) System

Booth 1760

- Provides real-time measurements of biomolecular interactions
- Micro or macro flow cells are available for different surface work
- Fluidic configurations range from manual to fully automated with an optional autosampler
- Can also be used to quantify adsorption and desorption processes in non-biological systems

Reichert
www.reichertspr.com

PRODUCTS IN ACTION

The world's most advanced Hybrid Microplate Reader

Synergy™ H4 with Hybrid Technology™ is a patent-pending multi-mode microplate reader that combines monochromator-based and filter-based optical systems in one compact instrument. It is the ideal instrument for research and drug discovery applications that eliminates having to choose between flexibility and performance. The monochromator-based optics provides a high level of flexibility; any wavelength can be used from the low UV to the near infrared; it is ideal for spectral scanning applications. The filter-based optics use dichroic mirrors for enhanced performance. This system is faster and more sensitive than the monochromator optics. A dual reagent dispenser option is available for inject and read assays such as flash luminescent assays and fluorescent ion channel assays. Additional read modes include: fluorescence polarization, time resolved fluorescence and AlphaScreen/AlphaLISA.

Synergy H4 is BioTek's newest multi-mode microplate reader. It belongs to the new class of Hybrid plate readers that combines monochromator and filter optics in one instrument.

Monochromators use diffraction gratings that physically separate the individual wavelengths present in white light coming from the instrument's light source. This offers several evident benefits. First, they are very convenient to use. The wavelengths to be measured are easily selected through the software and are generally available in 1 nm increments. Higher-end instruments often include a variable slit mechanism. Manipulation and storage of accessories are unnecessary, as in filter-based systems. Adjustments for new applications and wavelengths are simple, without an increase in time or cost for extra optical elements. In addition, monochromators can run spectral scans that can be used to characterize new fluorophores or study spectral shifts in some assays.

A filter-based optical system, all things being equal (quality of optical elements, power of light source, detector used) will be more sensitive than a monochromator-based optical system. Filter systems are more efficient at delivering light to the sample. They are also very efficient at providing correct light blocking between the excitation channel and the emission channel. A filter set can be specifically tailored to a particular assay (or fluorophore) to obtain maximum sensitivity. Filters can have a bandwidth anywhere between 5 nm to more than 100 nm, set in 0.5–1 nm increments. Monochromator-based optics usually come with a fixed or limited range of bandwidth selection. This bandwidth limitation is a problem with low-level fluorescence, where a large measurement bandwidth is necessary, such as AlphaScreen®/AlphaLISA® assays (PerkinElmer), which require a strong excitation and the use of a 100 nm emission bandpass.

Hybrid Technology, as found in the Synergy H4, is a significant step forward in the design of a new class of multi-detection microplate readers. By combining the benefits of filter-based and monochromator-based detection, Synergy H4 brings to laboratories a new level of flexibility and convenience. This design bridges the gaps highlighted previously, and provides a design that covers virtually all microplate-based applications.

The versatility of the Synergy H4 is expanded even more with BioTek's new Take3™ Multi-Volume, Multi-Sample Plate. This optional accessory allows measuring sixteen 2 µL samples in one run. The main application is low volume nucleic acid quantification at 260 nm, but many other applications are possible as the plate can be measured in fluorescence and luminescence mode

In summary, with its Hybrid optical system, and innovative Take3 Plate accessory, Synergy H4 is the ideal plate reader for laboratories running a wide variety of assays, from basic research to drug discovery applications.

BioTek®
Get a Better Reaction.

BioTek U.S.
100 Tigan Street
Winooski, VT 05404AA
888-451-5171
www.biotek.com

LIMS & SOFTWARE

HPLC Troubleshooting e-Learning Modules
Booth 4003

- How to identify problems and recognize the underlying causes
- Covers blockages, leaks, baseline/peak distortions, component malfunctions, etc.
- Customization capability enables you to add your own tips to the program
- Licenses range from short-term to permanent and single computer or network

Academy Savant
www.academysavant.com

MolAna™ Acquisition and Quantitation Software
Booth 1857

- Provides full data acquisition capability, including multiple overlapping experiments within the same method
- Enables a user to extract and perform quantitation for data collected in any analysis mode
- Includes a user-friendly, workflow-oriented interface and simple method setup
- Features fast curve fitting and integration and import/export capabilities

IONICS www.ionics.ca

Nexxis iLAB Laboratory Automation Software
Booth 3969

- Automatically delivers information from application to application in real time
- Updates informatics systems as events take place
- Provides real-time management of lab workflow
- Controls procedural execution and ensures that SOP requirements are always met

Labtronics
www.labtronics.com

Nexxis ELN Electronic Laboratory Notebook
Booth 3969

- Provides real-time workflow control and automation for R&D and QA/QC testing
- Includes a fully searchable system that provides instant access to worksheets and notes
- ReDI™ technology ensures rapid deployment, transforming existing paper documents into electronic forms that are ready to use in minutes

Labtronics www.labtronics.com

LimsLink Integration Software
Booth 3969

- Integrates any instrument to any LIMS, eliminating data entry errors and reducing data review and approval times
- Includes a fully searchable system for storing raw data
- Features automatic creation of worklists and sequence files and automatic calculations
- Interfaces are fully configurable without custom coding

Labtronics www.labtronics.com

UN-SCAN-IT Graph Digitizing Software
Booth 2903

- Automatically converts scanned graphs to useful (x, y) data using a simple drag and drop interface
- Works with any scanner or image input device
- Can digitize journal graphs, strip chart output, old graphs and other hard-copy graphs
- Able to integrate peak areas, smooth data, take derivatives, re-scale graphs and store data

Silk Scientific www.silkscientific.com

SmartLab CIMS^{plus} Freedom Workstation
Booth 3973

- Provides comprehensive tracking and tracing of all consumables
- Manages all workflows for lab consumables, reagents, solutions, columns, etc.
- Integrates with pH meters and balances
- Includes a bar code reader and printer for compliant control

VelQuest www.velquest.com

OEM Driver Software SeaBreeze
Booth 3131

- Basic starting platform can be customized by developers for their own applications and instruments
- Delivers faster processing and is compact enough to be built directly into spectral libraries smaller than 500k
- Can be adapted to new platforms by providing a native implementation of bus interfaces for the target
- Supports most Ocean Optics' USB spectrometers for Linux and Windows operating systems

Ocean Optics www.oceanoptics.com

Professional SaaS-based LIMS SciLIMS SSM: Professional Edition

- Eliminates restrictions in many areas (users, container types, storage units, etc)
- Customizable to the lab's requirements, without costly administration services
- Eliminates the need to purchase servers and maintain software
- Includes a 30-day money-back guarantee

Sciformatix www.sciformatix.com

SUPPLIES & CONSUMABLES

High-Performance Labels for Histology and Pathology

Booth 2110

- Include Flexible Lamination After Printing (FLAP) labels to withstand harsh chemicals and stains
- Labels designed to stay adhered to histology cassettes
- Designed to withstand the cryogenic process
- Available as print-on-demand in conjunction with CAB printers and label design software

Computype www.computype.com

Cryo Hold Liquid Nitrogen Blank Label

Booth 2110

- Fully customizable; designed and tested for cryogenic applications
- Extends Computype's Cryo Hold series for use with Liquid Nitrogen
- Resistant to harsh chemicals and extreme temperatures
- Customized to match any laboratory scenario

Computype
www.computype.com

InGuard™ Sample Prep Cartridges for Ion Chromatography

Booth 969

- Packed with resins to automatically remove matrix interferences (anions, cations, lipids, etc.)
- Plumbed directly after the injection loop and before the concentrator column, saving time
- Available in silver (Ag), hydronium (H), sodium (Na), hydrophilic reversed phase (HRP) and combined Na/HRP
- Each cartridge can be used several times before needing replacement

Dionex www.dionex.com

OxiClear™ Gas Purifiers

Booth 2837

- Feature low resistance to gas flow
- Remove oxygen and trace amounts of water and organics from inert carrier gases
- Efficient to less than 5 ppb when the incoming oxygen concentration is 15 ppm or less
- Able to withstand temperatures up to 100°C

LabClear
www.labclear.com

OC Line of Lubricants and Thread Sealants

Booth 3208

- Oxygen compatible and chemical-resistant
- Thermally stable over a wide temperature range
- Non-flammable, non-migrating, non-toxic, odorless, waterproof and chemically inert
- Suitable for high-pressure applications

MPT Industries www.mptindustries.com

Smart pH Cuvettes

Booth 3131

- Coated with sol gel embedded with Bromocresol Green pH indicator dye
- Available in plastic (PMMA) or quartz, and measure 1 cm x 1 cm
- Proprietary pH-sensitive materials can be formulated as self-adhesive patches and integrated into various sample containers
- Compatible with various sampling devices and fiber optic spectrometers and accessories

Ocean Optics
www.oceanoptics.com

Plastic Protective Packaging

Booth 4047

- Over 3,000 types and sizes of packaging for consumer and promotional items
- Markets include hobby/craft, cutting tool & engineered parts industries and DIY markets
- Provide custom design, development and production for specific requirements

Rose Plastics www.rose-plastic.us

National Scientific Mass Spec Certified Vials

Booth 2757

- Manufactured from inert, pure and chemically stable glass
- Produced under strict quality control protocols for uniformity
- Feature ultra-high purity bonded PTFE/silicone closures
- Each vial undergoes verification of 13 critical physical characteristics

National Scientific www.nationalscientific.com

A+ Single Element Calibration Standards

Booth 3341

- Designed for use in ICP-MS, ICP-AES, AA and other spectrometric techniques
- Assayed in accordance with the High Performance ICP (HP-ICP-AES) method developed by NIST
- HP-ICP-AES method ensures highest accuracy standards available
- Provides traceability to NIST

VHG Labs www.vhglabs.com

Microplate 2 mL Compound Storage Plate

- Provides high integrity sample sealing and near zero well-to-well cross contamination
- Manufactured from ultra-pure grade polypropylene under clean room conditions
- Contains no contaminants that can leach into stored samples
- Complies with ANSI/SBS dimensions, ensuring compatibility with all microplate readers, washers and automated equipment

Porvair Sciences www.porvair-sciences.com

Universal Valve Actuator

Booth 2315

- Covered by three actuator versions: high speed, medium speed/torque and high torque
- Includes a universal 24 volt DC power supply and manual interface
- CE/RoHS compliant
- Includes a variety of interface options including RS232/485, USB and BCD

Valco Instruments www.vici.com

HPLC Vials Prominence

Booth 2069

- The 1.5 mL and 4 mL sample vials use a PTFE/silicone septum
- Uniformity of vial bottom thickness ensures consistent needle depth from run to run and minimizes user intervention
- 6 mm opening provides a better target for autosampler needle, for easier filling
- Available in 1 mL, 1.5 mL, 4 mL, 13 mL, 200 µL and 300 µL sizes

Shimadzu www.ssi.shimadzu.com

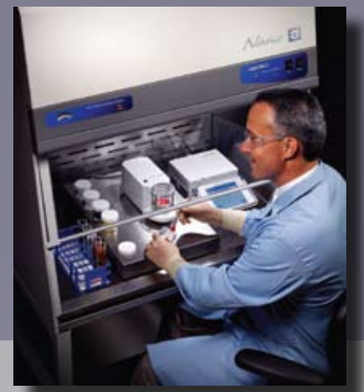
PITTCON BOOTHS 1020, 1021

PRODUCTS IN ACTION

Nanotechnology Enclosures & Cell Logic Biosafety Cabinets

NEW XPert® Nano™ Enclosures protect users during nanoparticle manipulation and dry powder chemical handling.

New XPert Nano Enclosures provide user protection by keeping hazardous powders and particulates contained during procedures such as nanoparticle manipulation and dry powder chemical handling. The patented containment design filters the air through a 99.999% bag-in/bag-out ULPA filter before returning the clean air to the laboratory. The all stainless steel interior (sides, work surface, removable baffle and removable airfoil) is designed for easy wipe down and cleaning procedures. An optional built-in ionizer neutralizes static charge on interior surfaces by emitting ions into the airstream, which helps reduce weighing errors and attraction of particles to the enclosure surfaces. The XPert Nano is the first and only enclosure validated for nanomaterial containment.



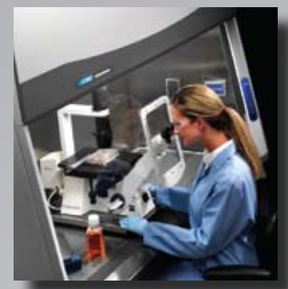
New Purifier Cell Logic Biosafety Cabinets safely accommodate a microscope and keep samples at optimum temperature.

Labconco recently designed a biosafety cabinet specifically for cell culture and cell research applications. The Purifier® Cell Logic® incorporates several unique features into the biosafety cabinet to facilitate cell culture procedures. With the Cell Logic, scientists can clearly and safely use their microscope inside a biosafety cabinet without vibration issues while accurately maintaining sample temperature.

The Scope-Ready™ package incorporates the Pure-Vu™ eyepiece seal into the biosafety cabinet's glass sash and is designed to accommodate a wide range of microscope sizes and configurations, including inverted and stereo scopes. The Pure-Vu seal ensures user safety and provides protection against contamination of the sample. The Pure-Vu seal has passed ASHRAE testing and meets the requirements for NSF 49 compliance. Other manufacturers have designed microscope seals that are opaque, limiting the user's vision of the sample at all times inside the biosafety cabinet. Labconco solved this problem using an exclusive material that is both chemically resistant and flexible, while also being completely transparent.

The Scope-Ready package also includes a vibration isolating microscope base plate. The Stand-Still™ isolation platform isolates cabinet vibration from the microscope, providing a 300% improvement in microscope stability. In addition, the Stand-Still isolation platform helps maintain airflow across the work surface to prevent areas of static airflow under the microscope.

Another package available on the Cell Logic is the Temp-Zone™ work surface. During cell culturing and research procedures samples are often incubated for growth or chilled for preservation. These samples are susceptible when removed from the heated or chilled environment. Labconco designed the Temp-Zone work surface to maintain the sample media temperature. The Temp-Zone work surface can be chilled to 2° Celsius or heated to temperatures exceeding those needed for cell culturing procedures. Distinctive laser micro-etching outlines the Temp-Zone area for the user without sacrificing cleanability of the work surface.



The Cell Logic also includes the unique and patented features of the Purifier Logic Biosafety Cabinet. The electronically commutated motor (ECM) is the most energy efficient motor technology in the industry. Labconco's patented airflow monitoring technology utilizes the ECM to precisely maintain the proper airflow through the biosafety cabinet. In addition, the LCD display is conveniently located and displays valuable information to the user. An industry first, the Filter Life Remaining bar graph takes the guesswork out of when to replace the biosafety cabinet's HEPA filters. The LCD display also provides visual indication of alarm conditions and incorporates interval and countdown timers.

The Cell Logic can be configured in three ways – Scope-Ready, Temp-Zone, or Scope-Ready plus Temp-Zone. Please contact Labconco for help determining which configuration is most appropriate for your customer.

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Production of 3D Cell Cultures

Problem: Conventional cell cultures are conducted in cell culture vessels such in 96-well cell culture plates. While culturing cells in 2D is convenient it may be unrepresentative of living cells, which usually grow in 3D while building living tissues and organs. Emerging evidence has suggested that 3D cell cultures offer important advances. Studies have shown that human annulus disc cells cultured in 3D gel systems showed different morphology than those cultured in 2D. 3D cell culture is also a better model for studying the interactions between cell and growth factors as well as cells and therapeutic agents. 3D cell culture systems can also facilitate the understanding of the structure-function relationship in normal and pathological conditions.

3D Biotek was founded in 2007 with the goal of developing 3D porous devices for stem cell culture, tissue engineering and drug discovery applications. The company immediately set out to develop a solid porous scaffold that could be used to conduct 3D cultures. The biggest challenge in producing the 3D scaffolds is that various sub-systems of the micro-fabrication platform need to work together seamlessly in order to fabricate the scaffolds with the designed pore size and porosity, which in turn, requires a motion and positioning sub-system with high precision. "Most of the gantry systems that we looked at did not have the accuracy to maintain the precise positioning of 10 microns or so required for our applications," said Wing Lau, chief operating officer of 3D Biotek.

▲ *The Techno Gantry System LCT.*

Solution: Then Lau identified the Gantry System LCT from Techno, Inc. The Techno Gantry System LCT is equipped with ball screws on all three axes with closed loop servo motor drives that provide an accuracy of +/-100 microns per 300 millimeters (mm) and a repeatability of +/- 100 microns. The critical dimensions are the pore sizes, which range from 200 to 500 microns. Over a distance of 500 microns, the accuracy of the Gantry System LCT is less than 1 micron so the machine can hold pore size to much tighter tolerance than is required. The Techno machine also provides a speed of 152 mm or 6 inches per second, which is fast enough to achieve high production rates.

3D Biotek developed a Fabrication Program with Microsoft .NET technology that accepts as input basic parameters of the scaffold, such as the outer dimensions and pore size. The program then generates a G-code toolpath file that guides the machine through the intricate series of motions required to produce the scaffold.

"The introduction of 3D Insert will significantly change the current cell culture landscape," Lau concluded. "3D Biotek believes that the 3D scaffold will enable a revolutionary transition from 2D to 3D cell cultures. The better correlation between the results from in vitro 3D cell culture with the preclinical model and human patient will decrease the overall therapeutic and pharmaceutical product development cost and shorten the time to market."

For more information go to www.technocnc.com.

▲ *PCL scaffold with pore size ~ 500 microns.*

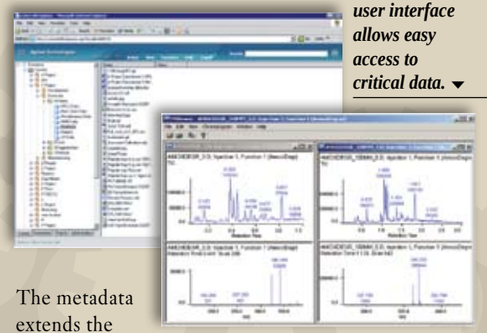
Managing R&D Data

Problem: Laboratory Information Management Systems (LIMS) are essential tools for managing data for QA/QC/Process labs throughout the chemical and petroleum industries. However, the rigid database structure requires strict standardization of test conditions and results in order to populate predefined reports or integrate into distributed control systems. While this attribute is highly desirable for these routine labs, it creates problems for R&D labs where tests conditions are frequently modified or procedures are altered for a particular project. In these non-routine environments, LIMS are used primarily for sample tracking purposes rather than for data management. Non-routine, non-standard testing labs need a more flexible means for managing data that provides organized storage while retaining the ability for search and retrieval when required.

Solution: Agilent Technologies OpenLab ECM software provides a versatile complement to LIMS

for storing and managing non-routine data. This open architecture system can automatically collect, classify, and store data acquired from nearly all types of laboratory instruments as long as it is in electronic form (Figure 1). Scheduling agents "crawl" through the LAN to collect all types of files from pre-defined locations at specified times, create meta-data from the files for advanced indexing capabilities, and store all data securely in a central repository. The agents can retrieve files from any LAN-connected computer including personal machines. This allows all types of data for a project, including data contained in e-mails that were previously relatively inaccessible, to be brought together in a single location. This facilitates sharing of information among project members, reduces the loss of knowledge when team members depart, and secures intellectual property to support any patent applications that might result from the project. The system has multi-level security that strictly limits access for each folder to authorized users and limits functional capabilities based upon the permission level granted by the folder administrator. Data are viewed through an intuitive user interface that facilitates the easy manipulation and comparisons needed to extract the critical information required to solve a particular problem (Figure 2).

▲ *OpenLab ECM manages data and business processes for all R&D projects.*



OpenLAB ECM simple user interface allows easy access to critical data. ▼

The metadata extends the search capabilities so that data that were not recognized as relevant at the time of collection can still be easily searched and retrieved. For example, if a researcher observes an unexpected peak in a chromatogram, he can query the system and nearly instantly retrieve all chromatograms containing a peak with the same retention time. The system also has a business process module that automates and manages the lab's workflow so that tasks such as approvals, release of reports, instrument maintenance, document control, and so forth can be assigned and tracked. And, the software is scalable so that it can support a single workgroup or an entire company.

As resources have declined over the past decade, it has become even more critical for laboratories to increase productivity in order to continue to meet the needs of the business. Data management has been identified as a major bottleneck for most labs and thus presents a significant opportunity for increasing productivity by reducing the manpower lost to tedious tasks such as filing, collating, searching for information, etc. While the actual time spent on these tasks will vary from lab to lab, most labs identify these tasks as an impediment to their operations that detracts from time spent on the science. For labs generating large quantities of data, the financial payback can easily be less than one year.

For more information go to www.chem.agilent.com/en-US/Products/software/datasystems/openlab/Pages/default.aspx.

HPLC Core-Shell Particle Technologies

Problem: Chromatographers have an ongoing need to increase productivity and decrease costs. This can be accomplished in part by leveraging higher efficiency HPLC columns to increase analysis speed. Significant improvements have been made in the preparation of sub-2 µm HPLC packing materials, which provide high-efficiency separations in less time when packed in shorter columns. Unfortunately, columns packed with sub-2 µm particles typically generate pressures that exceed the limits of standard HPLC instruments and require the use of ultra-high pressure HPLC systems, which can be cost-prohibitive.

Solution: Kinetex™ core-shell HPLC particle technologies provide a high-efficiency, low-pressure solution for laboratories looking to increase productivity and decrease costs without investing in a UHPLC system. Core-shell particles can be used with high mobile phase flow rates to further reduce analysis time without significant losses in separation efficiency, whereas the performance of fully porous particles begins to drop off sharply at high flow rates. The chromatograms shown in the figure demonstrate the potential of Kinetex HPLC columns to reduce analysis time, compared to traditional 5 µm fully porous particles, without compromising analyte resolution or generating extreme backpressures.

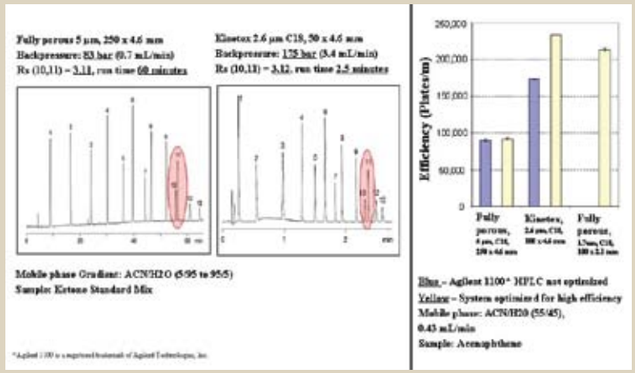
UHPLC systems have been engineered with sub-2 particle, high-pressure applications in mind, resulting in complex pump redesigns that add significantly to system cost. However, investigations have shown that straightforward adjustments can be made to existing HPLC systems to significantly increase performance with core-shell columns. These adjustments, which include increasing detector scan rates and reducing system dwell volume require little to no additional investment. The column charts (right) show the effect of HPLC system optimization on the separation efficiency observed with Kinetex compared to 5 µm fully porous particle columns and how those values compare to 1.7 µm fully porous columns used with UHPLC systems.

The high separation efficiency of core-shell particles is due in large part to faster analyte mass transfer from the mobile phase into and out of the stationary phase because only the outer porous layer of the particle allows diffusion. A 2.6 µm Kinetex core-shell particle has a non-porous core approximately 1.9 µm in diameter and an outer porous layer of 0.35 µm. These core-shell particles also have exceptionally consistent shape and size, which helps to improve separation efficiency by reducing the variability in analyte movement between particles. The improved dynamics of analyte movement through these columns results in higher effective peak capacities and separation efficiencies comparable to those of fully porous 1.7 µm particles. However, because the core-shell particle diameter is 2.6 µm, the backpressures generated are more comparable to those of columns packed with 3 µm fully porous particles. Kinetex columns are also available with 1.7 µm particles, which provide even higher efficiencies than the 2.6 µm but also result in higher backpressures.

Core-shell technology can increase productivity in the laboratory today, allowing for an upgrade in the performance of conventional HPLC instrumentation to compete on a new level of speed and performance.

By Jerry Fields, Technical Specialist, Phenomenex

For more information go to www.phenomenex.com/Phen/EM/ws63990808/technology.html.



▲ *The chromatograms above show the separation of a ketone standard mix using traditional 5 µm fully porous particles (left) and Kinetex core-shell columns. The bar chart (far right) shows the effect of HPLC system optimization on the separation efficiency observed with 5 µm fully porous particle columns, Kinetex core-shell columns and 1.7 µm fully porous columns used with UHPLC systems.*

Marketplace

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PARTING POINTS

Takeaways from this month's issue:

Moving Forward, p. 10

Although 2009 was a very difficult year for many companies and organizations, the ones who survived have a clear understanding of what they need to do to begin moving forward. Here are some of the ways they are going about it:

- Being aggressive: continue to seek out new markets, networks and contacts
- Saving money: consider used equipment and supplies
- Investing in technology: modern technology keeps labs relevant and productive

Sharing the Workload, p. 26

A chromatographic laboratory quality team used Six Sigma statistical tools to measure variation between analysts to effectively cross-train spectroscopy analysts to handle chromatography. An exhaustive analysis of errors was derived from Gage R&R studies. After training, the data from the second-phase Gage R&R studies showed:

- Higher part-to-part variation (97 percent)
- Improvement in precision
- Improved reproducibility to 15 percent after analyst training
- Total Gage R&R of 22 percent—within the acceptable range.

Ask the Expert: Setting Up a High-Throughput Screening Lab, p. 38

Here are some of Dr. Hakim Djaballah's suggestions to keep in mind when setting up a HTS lab in an academic environment:

- Put together a realistic initial budget and business plan
- Start out with no more than two people, or else things can get disastrous; get them trained first and then recruit more people
- If you buy more than you initially need, you can hurt your capital investment

Selling Ideas to Upper Management, p. 40

To sell ideas to upper management, you need to tap into the same creativity you and your staff used to conceive them. Prepare a clear, concise report (oral or written) as follows:

- Summarize your idea
- Define its need; what problem will it solve?
- Explain its financial benefits
- Define the required resources
- Request a commitment and follow up

Coloring Outside the Lines, p. 68

Today's lab managers are expected to produce scientifically relevant results that are on budget, on time and profitable. Here are some tips to be innovative and rethink your approaches:

- Question the norm
- Look at challenges from several different perspectives
- Be creative to increase the value of your work
- Develop techniques to effectively manage change
- There can be many answers to a challenge or problem

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