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ASMS 2017: Consumables and Software Introductions Complement New Systems

The American Society of Mass Spectrometry (ASMS) held its 65th annual conference from June 4 to June 7 at the convention center in Indianapolis, Indiana. Attendance totaled 6,338, up slightly from last year's figure of 6,267 (see

IBO 6/15/16). The 2018 ASMS conference is scheduled to occur from June 3 to June 7 in San Diego, California.

Agilent Technologies

Agilent Technologies' signature announcement was the unveiling of the Ultivo Triple Quadrupole LC/MS. At 15.4 in wide, it is 70% smaller than Agilent's 6460 LC/MS System, enabling it to fit perfectly underneath Agilent's Infinity II HPLC stack. Designed for high-throughput applications for mass ranges below 1450, it is ideal for food safety and environmental analyses. The instrument is expected to ship this fall and sell for over $300,000.

Agilent also introduced the 7250 GC/Q-TOF, which features a combination of a high-resolution, accurate mass GC/MS and a low-energy ionization source, thus allowing low-energy electron ionization compound identification in complex matrices.

Bruker

Bruker showcased several new innovative software solutions. This included SCiLS Cloud, which offers web-based tools to facilitate distributed workflows, and SCiLS Lab, which provides solutions for data handling and computational analysis for Bruker MALDI imaging data sets. For life science and translational research, the company also introduced MetaboScape 3.0, its third-generation metabolomics research and validation solution that utilizes powerful data extraction with its new T-ReX 2D algorithm. In addition, the company launched Proteoform Profiling 1.0, which can be used with Bruker's nanoElute UHPLC for cell biology and clinical proteomics research. Bruker also announced the release of TargetScreener 3.0 HR, a platform for automated screening and quantitative applications in forensic, food and environmental safety markets.

SCIEX

Like Bruker, SCIEX introduced new software, but its latest offering is aimed at applied and industrial markets. The software supports new applications for SCIEX's SWATH acquisition technology, which for the past five years has been used only for proteomics research and allows simultaneous and comprehensive identification and quantification of compounds within a sample. SWATH now supports forensic analysis with the ability to routinely screen and quantify drugs and medications in numerous biological matrices; food testing through the reduction of false negatives and the ability to re-analyze results without needing the original sample; and environmental analysis due to reliable compound identification and quantification.

SCIEX further announced that it has developed a Vitamin D 200M assay, the first and only FDA-cleared LC/MS–based Vitamin D assay. The company decided to develop this assay since Vitamin D is an important building block and biomarker for health, and also because it is among the top five assays reimbursed by Medicare. It is designed to be used on the soon-to-be-released SCIEX Topaz LC/MS System for clinical labs. This instrument will enable clinical labs to expand their in-house testing, as well as add their own LDTs. SCIEX anticipates that the Topaz System together with its Vitamin D assay will be a door opener for hospitals and clinical labs that want to access MS.

The company also introduced advanced and routine metabolomics software for the X500R QTOF, a simplified solution for the routine core-lab MS user, allowing quantitative and qualitative data collection.

Shimadzu

At the show, Shimadzu previewed its new MALDI-8020 Benchtop MALDI-TOF MS as an extension of the company's MALDI product portfolio. The instrument features a compact design with an integrated barcode reader and easy-to-use interface that requires minimal clicks. It is capable of fast analysis with a 200 Hz solid state laser and 90 second pump-down time. The instrument is slated for release in the fall and although a list price has not yet been set, it is estimated to be between $100,000 and $150,000.

The company also released hardware upgrades to its GCMS-TQ8050 system, as well as the nSMOL (nano-Surface and Molecular Orientation Limited proteolysis) Antibody Bio-Analysis Kit. nSMOL is a novel method of sample preparation for LC/MS bioanalysis of monoclonal antibodies in blood. It eliminates the steps of denaturing, reduction and alkylation normally associated with protein digestion, which results in more efficient sample preparation and analysis. It is also the only reagent kit that clears the guideline standards issued by the US FDA and Japan's MHLW.

Shimadzu also announced an agreement with Québec-based Phytronix Technologies to offer the first triple ion source for Shimadzu's LC/MS systems. The configuration is ideal for both screening and confirmation work. Able to perform analysis in less than four seconds, it is designed to improve productivity in high-throughput labs performing toxicology, drug discovery and food safety applications.

Thermo Fisher Scientific

Thermo Fisher Scientific had several new product introductions. Enhancements were introduced to its flagship product, the Orbitrap Fusion Lumos Tribrid MS. These new options include Ultraviolet Photodissociation (UVPD) that allows for large and small molecular structure determination on an LC time scale; an Advanced Peak Determination (APD) algorithm that assigns more monoisotopic peaks and charge states in complex spectra to deliver more unique peptide identifications; and 1M resolution, which resolves fine isotope structure and can separate isobaric compounds.

The company also introduced the Thermo Scientific TSQ Altis and TSQ Quantis triple quad MS systems. The TSQ Altis is a high-end instrument that offers high sensitivity, selectivity and speed, and replaces the TSQ Quantiva. It is able to perform 600 experiments per second. In contrast, the TSQ Quantis is more of a mid-range, quantitative workhorse instrument, supporting routine workflows and replacing the TSQ Endura. Reproducibility is enhanced by a new front end, optics and quadrupole system, according to the company. Ease of use was also a strong consideration in the design.

Also launched at ASMS was the Thermo Scientific Q Exactive HF-X Hybrid Quadrupole Orbitrap MS, a high-end addition to the Exactive family, featuring improved sensitivity and speed, and designed to support workflows in proteomics and metabolomics. While earlier models operate at 20 Hz, the scanning speed of this system is at 40 Hz, enabling analysis of the same results in half the time.

Thermo Fisher also announced new consumables for MS. Together with BIOCRATES Life Sciences, Thermo Fisher launched the BIOCRATES Absolute/*DQ* p400 HR kit for metabolic phenotyping on high-resolution MS instruments. It will be jointly promoted for use with the Thermo Fisher Q Exactive models. Also introduced was the Thermo Scientific InsuQuant Mass Spectrometric Immunoassay Kit for the insulin bioanalysis workflow.

As with other companies, software was also a part of Thermo Fisher's product introductions. The company had several new releases for MS software and cloud-based solutions to support applications in proteomics, metabolomics, genomics research and applied markets. Among the new software announcements was a comarketing agreement with Biognosys to provide a comprehensive, efficient workflow to enable library creation and data processing for data-independent acquisition studies through the combined use of Orbitrap MS systems, including the Thermo Scientific Q Exactive HF-X Hybrid Quadrupole Orbitrap MS, and Biognosys' Spectronaut Pulsar software.

Waters

Waters introduced LiveID Software for food authenticity analysis on its Xevo G2-XS and SYNAPT G2-S*i* quadrupole TOF MS systems. It also announced a new version of its Progenesis Qi P software, which supports proteomics and metabolomics workflows, as well as SONAR, a recently introduced data-independent acquisition mode for Waters' high-resolution MS instruments. The new version will be available in July.

Waters also announced two collaboration agreements. It will make available IonSense's open-air DART ionization source as an option for its ACQUITY QDa Mass Detector. DART requires little to no sample preparation and can detect substances on a variety of surfaces, including human skin, vegetables and fruit, and clothing. The addition is expected to broaden the applications for the ACQUITY QDa. Under a comarketing agreement with Andrew Alliance, Waters will combine its Glycoworks *Rapi*Fluor-MS N-Glycan Kit for glycosylation profiling with Andrew Alliances' Andrew pipetting robot for semi-automated sample preparation.

Food Safety Testing in China: On the Fast Track

Food safety testing has been a booming market in China for instrument companies, especially since the new Food Safety Law was implemented in fall 2015. The rapid traction that food testing is gaining in China has resulted in many opportunities for instrument companies in the market. Although there are subtle differences in the way food testing is carried out in China, the overall process is quite similar to the US.

In April, the State Council for the People's Republic of China released a new guideline emphasizing proper management and structural reform for the food testing industry, urging federal departments to hasten the development of a legal system that will eliminate the manufacture and sale of fraudulent foods. The guideline also indicated that food-related industries (i.e., environmental) are required to implement "agricultural standardization." These objectives are achieved in part through obtaining certifications from federal agencies and passing inspections by QC organizations, such as pre-shipment, during production, loading and food check inspections.

Compliance and Lab Types

AsiaInspection (AI) is a prominent Hong Kong-based QC and compliance company that provides QC services for a variety of industries, including apparel, jewelry, cosmetics and food. Within the food industry, AI provides QC and compliance services for fresh and processed foods, seafood, meat and poultry, and beverages, as well as food containers. The company also conducts supplier audit programs, product inspections and lab testing.

> ***A significant aspect of China's food safety plan is to "align China's food safety standards with international standards."***

According to Sebastien Breteau, founder and CEO of AI, the latest research indicates that the food safety testing market in China is poised for a 9.9% CAGR between 2016 and 2020, ultimately reaching $791.5 million in 2020. "Over half (55%) of this market currently belongs to state-owned testing organizations," Mr. Breteau told ***IBO***. "The rest is divided between private testing companies, with foreign ones taking prevalence—35% of the total [market] or over 75% of the private food testing market." Mr. Breteau explained that there are requirements that third-party labs must meet in order to test food in China, such as the mandatory accreditation by the China National Accreditation Service for Conformity Assessment (CNAS) and the China Metrology Accreditation (CMA). "In addition, China's state certification and supervision departments are looking to work with certification agencies to offer voluntary product certification in such areas as organic foods, environmentally friendly products, energy and water saving initiatives, pollution-free agriculture, etc.," he noted.

As Mr. Breteau indicated, since the frameworks concerning the Food Safety Law are still under development, so is implementation. "The new Food Safety Law is at the core of China's five-year food safety plan, which will see the creation of a comprehensive legislative system featuring the implementation rules for the Food Safety Law, a number of administrative rules (for pesticides, fertilizers, soil pollution, dairy products, etc.), [and] multiple regulations on food labeling, traceability, information disclosure, incident investigation, import/export oversight, and more," he explained. A significant aspect of this plan, Mr. Breteau stated, is to "align China's food safety standards with international standards."

Consequently, because the regulations involving standards and laws are still under development, unlike in the US, the food safety testing processes will have to adapt to the resulting regulations. "The scale of changes in China's food safety is unprecedented—some 300 national standards will be updated or developed over the next five years, plus 6,600 maximum residue limits for pesticides and 270 limits for veterinary drugs," Mr. Breteau said. "We expect it will take food testing laboratories 1–2 years to be fully aligned with the new regulations."

Similar to the US, Chinese food testing labs usually fall into certain segments. As Yao Liang, senior segment specialist at PerkinElmer, explained, in China, there are three levels of labs that carry out food safety testing. First-level labs are comprised of government labs, such as national, provincial and certain higher-education labs. "These

labs do food safety testing to help supervision and build standard methods," Mr. Liang explained. Second-level labs include third-party testing labs which "see food safety testing as a business," as Mr. Liang stated. "[These labs] help government and food companies do testing and provide testing data," he said. "The labs in large food companies serve the role of testing centers for branches of the companies." Finally, third-level labs conduct internal QC through their food safety testing, he stated.

When it comes to routine food testing, the majority of national and provincial labs have adequate capabilities, according to Yuhong Chen, Great China food market manager, and John Lee, global food market manager at Agilent Technologies. "In recent years, the government has focused more on improving the capabilities of local labs (i.e., city & county labs)," said Mr. Chen and Mr. Lee. Some of these labs are upgraded from existing labs, while others are brand new. "Food safety risk assessment is mainly [conducted] in national, provincial and city labs," explained Mr. Chen and Mr. Lee. "Most of them are upgraded existing labs," they noted, rather than brand new labs.

Training and Support

The level of expertise in Chinese food testing labs is largely based on the type of lab. Generally, as Mr. Liang stated, "[D]ifferent labs have different training needs. Some may focus on future applications, some may just follow the standard methods." In first-level government labs, such as labs at the CFDA, CDC and higher-education labs, there is already an established use of analytical instruments, as Mr. Liang explained, such as GC, LC, AAS, ICP-MS and LC-MS/MS. "[Here,] the training needs change gradually from how to use these instruments to how make good use of instruments," he said. "They are focusing more on application direction." For second-level labs at major food companies or third-party testing labs, Mr. Liang stated. "[These labs] are focusing on the [complying with the law] and efficiency," he said. "Training needs for them are more about equipment maintenance and application." Third-level labs are within medium- and small-sized food companies, he said. "They use instruments just to meet the demand of China food safety regulations." He added, "They need training on how to test the food according to the standard methods."

A focus on application training is common in food testing labs in China. "In addition to basic product training (e.g., principle of products, hardware and software, daily maintenance and troubleshooting skills), there may be more dedicated application training sessions which would augment food regulations/standards training, and may be required by some food testing labs," said Mr. Chen and Mr. Lee. "Usually, application training would include topics such as sample preparation, instrumentation optimization, key points and tips for the method, data processing and potentially customized reporting."

> ***"We expect it will take food testing laboratories 1-2 years to be fully aligned with the new regulations."***

Additionally, as Mr. Chen and Mr. Lee explained, on-site application trainings conducted by analytical instrument vendors are preferred. "In each sub-segment, to improve the competency of the whole industry, some top-level labs also help the government organize the training periodically in that sub-segment," said Mr. Chen and Mr. Lee. "[For example], the Chinese Academy of Agricultural Sciences (CAAS) helps organize a series of training on pesticides, vet drug, heavy metals, feed testing and food risk assessment training for Ministry of Agriculture (MOA) labs every year."

This contrast in different training needs among different level labs is similar to the training process in US food testing labs, though there are some differences, according to Robert Packer, portfolio director, Infrared, at PerkinElmer. "In the US, private labs typically have high employee turnover rates and, as such, require more frequent new-user training," Mr. Packer explained. "Government labs also differ in the US, in that they usually obtain their applications' direction from bodies such as the AOAC and [its] working groups to develop methods using a wider spectrum of the industry."

Service and support is a key component in Chinese food safety testing labs, with fast responses to customer requests being a major factor, according to Mr. Chen and Mr. Lee. Some customers may be wary about high support fees and prices of parts, making cost an issue. Customers also hope that the service engineer can provide comprehensive support for hardware and software, as well as applications. "For example, if a customer is having an issue obtaining the appropriate data for the targeted compounds in a specific matrix, but they are unsure of the reason, they would

hope that the engineer could help them check the instrumentation hardware/status and solve the application issues together," explained Mr. Chen and Mr. Lee.

Mr. Liang echoed these sentiments. "In China, instruments maintenance service and support is the most important need for almost all China food testing labs," he said. "Method development or method building comes next."

This is akin to the support desired from US food testing customers. "In the U.S., method development support is also important with companies willing to pay for this assistance," noted Mr. Packer. "In terms of general instrument maintenance and service, companies are often willing to pay for preventative maintenance contracts but not to the extent seen in the pharma market; as such, some smaller companies will learn to handle general maintenance in house."

Expenditures and Budgets

Certain labs' unwillingness to pay as often or as much for maintenance support may sometimes be a result of their budgets. In China, food testing labs' expenditures are, in a sense, subject to government approval. "The purchases are federally mandated, in that the facilities, instruments and consumables must adhere to the requirements for the lab's CNAS and CMA accreditation," Mr. Breteau explained. "In turn, the China Food Safety Regulation Framework and the criteria established in the China Food Safety Standards are in line with CODEX standards."

> ***"In the U.S., private labs typically have high employee turnover rates and, as such, require more frequent new user training."***

This process has many parallels with US food safety testing. "In the US, the types of labs and the testing they carry out is very similar to China," said Mr. Packer. For instance, the USDA's Accredited Laboratory Program provides accreditation to nonfederal chemistry labs to test meat and poultry, as the Food Safety Modernization Act (FSMA) requires certain food testing to be conducted by accredited labs. This creates an association between commercial, third-party, and foreign labs and domestic government labs. The US government also provides funding for labs through its food safety initiatives, such as the aforementioned FSMA and the USDA's Food Research Initiative. "With many US and non-US global food companies with facilities in China and the US, plus cooperation between the US FDA and the Chinese CFDA, the two models are similar," Mr. Packer explained.

When it comes to the budgets of Chinese food safety testing labs, expenditures and funding is varied greatly. "There are currently no federal- or province-level restrictions for a food testing laboratory budget," explained Mr. Breteau. "In practice, a testing lab's budget can range from hundreds to tens of millions RMB, depending on the size of its facilities, variety of equipment and scope of testing services (different product groups, a variety of standards, water and soil testing, etc.)."

For Chinese testing labs, budgets can be limited, but not fixed. "Constrained means there is always a plan for the budget," said Mr. Liang. "Flexible means the number and the specifications of the instruments can affect the budget."

Much is dependent on what type/level the lab is. As Mr. Chen and Mr. Lee explained, federal labs receive their budgets from central and district governments. "In the past five years, the government has heavily invested in building up food inspection capabilities and improving the competency of food testing labs, and it will continue to invest in this over the next five years," said Mr. Chen and Mr. Lee. "The government has overall plans on its investment in each food sub-segment, focusing on different purposes."

For example, as Mr. Chen and Mr. Lee explicated, for different level labs that are in the same sub-segment, the requirements differ based on testing capabilities. "The labs submit the budget request to the government," said Mr. Chen and Mr. Lee. "The budget requirements are dependent on which sub-segment the lab is from (e.g., FDA, MOA, [Ministry of Health], [State Administration of Grain], [General Administration of Quality Supervision, Inspection and Quarantine], etc), what level (e.g., central, province, city or county level), what kind of instruments the labs already have, how big the workload is, etc." Therefore, the budgets of federal food testing labs in China are more constrained and fixed, but since they are funded by the government, they are likely to receive a higher overall budget, as Mr. Chen and Mr. Lee indicated.

However, for third-party labs, the size of the budget depends on the type of lab. “If [the third-party lab] has a governmental background, it may get the budget support from the government, and may be able to afford the expense by itself,” said Mr. Chen and Mr. Lee. “While for the foreign-owned or private third-party labs, normally they need to afford the budget themselves due to self-financing.” Consequently, the budget for third-party labs is more constrained, according to Mr. Chen and Mr. Lee.

Customization as a Service

Since some Chinese food testing labs may be dealing with constrained budgets, instrument companies focus on meeting their unique needs to ensure they get the most out of the business partnership. For example, sometimes it is necessary for companies to tailor their instrumentation and consumables to meet customers’ needs, and companies can use their experience with US customers to inform their product development in China. As Mr. Chen and Mr. Lee explained, testing for multi-vet drug residues is currently a “hot topic” in China as well as globally. The majority of food testing labs in China follow MOA Notice 235, the chief regulation on the maximum residue limit for vet drugs. Traditionally, Mr. Chen and Mr. Lee stated, methods have involved dividing sample preparation and instrument measurement into different classes, which, excluding the matrix issues, can be challenging and time consuming. “Focusing on customers’ pain points and challenges, last year Agilent launched a vet drug application kit tailored for multi-vet drug testing that followed MOA Notice 235,” Mr. Chen and Mr. Lee told ***IBO***. “The core of this solution is a sample preparation method ([an] innovative EMR technique to deal with high-fat matrix) and an optimized acquisition method for triple quadrupole LC/MS, from sample prep to reporting [and] analyzing 189 vet drugs by one injection. Complementing the workflow solution are supplies and application services that guarantee a fast start-up of [using] the application in the laboratory.”

The kit covers a broad array of animal-derived food matrices, such as beef, bovine liver, pork, swine liver, chicken, fish and eggs. The kit will be upgraded to include more compounds and matrix solutions when they become available. “Since vet drug testing is a hot topic globally, the kit was developed under the great teamwork between LC-MS and consumables application experts in Agilent in different regions,” said Mr. Chen and Mr. Lee. “Based on the deep insights and rich experiences from US customers, these experts provided much of the input for this solution.” Though the solution mainly addressed the MOA Notice 235 in China, Mr. Chen and Mr. Lee indicated that it also covers the majority of analytes of vet drug residues that are required to be monitored in the US.

Another example is Agilent’s Intuvo 9000 GC, released in August 2016, which integrates GC, consumables, supplies, services and software. This system is “highly suitable” for third-party labs, Mr. Chen and Mr. Lee stated, as it has simplified food testing by making it smarter.

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PerkinElmer also developed a new method to address customer needs. For testing for lead in food products, AAS is the standard testing instrument, but Chinese sample methods involve long testing times (up to two hours per sample). “To increase testing speed , PerkinElmer developed a sample preparation method [that] cooperated with AAS, cutting the testing time from 2 hours for a sample to 10 minutes for a sample,” said Mr. Liang. “This new sample preparation method can now be used in dairy and edible oil testing.”

Similarly, in the US, PerkinElmer developed its innovative StayClean hot-surface-induced desolvation technology to address customer concerns. “In the US, there were often requests from food customers that their QQQ-MS technologies they were using required frequent cleaning,” said Mr. Packer. “This prompted PerkinElmer to design the QSight 200 QQQ MS with its patented StayClean source to help the food industry maximize uptime.”

Growing Segments

Maximizing uptime is an important factor in a market with rapidly growing segments. Routine analysis, which adheres to federal regulation requirements, and food safety risk assessment testing have become increasingly prevalent in the Chinese food testing market, with government labs performing the majority of these tests, as Mr.

Chen and Mr. Lee stated. “Most of these customers are interested in unknown screening, harmful substances (e.g., pesticides residues, vet drugs residues, heavy metals, bio-toxins, organic pollutants, illegal additives, etc.), as well as metabolites, food fraud, food geography origin, etc.,” they said. Both hardware and software are of utmost importance in these instances. “Agilent provides a total MSD portfolio from LC-QQQ, LC-Q/TOF, to GC-MS, GC-QQQ, GC-Q/TOF and ICP-MS with MPP (mass professional profiling) software to help the success of these customers,” Mr. Chen and Mr. Lee added.

Other fast growing segments for food safety testing in China include pesticide residue, mycotoxin and veterinary drugs residue testing, according to Mr. Liang. This is parallel to the US, where these segments are also growing at a rapid pace. Mr. Packer notes that food adulteration and authenticity is also growing quickly in the US, but “from a small base.”

Food safety testing in China is a flourishing market, and, according to Mr. Chen and Mr. Lee, the Chinese government’s emphasis on food safety control has resulted in an emphasis on food safety inspection. Of the federal, third-party, food enterprise and higher-education food testing labs in China, Mr. Chen and Mr. Lee stated that third-party labs have grown exponentially in recent years. “Most of the requirements from third-party food labs are mainly for routine testing following up the food regulations,” said Mr. Chen and Mr. Lee. “The biggest challenges for them are more samples, more analytes, more complex matrix, lack of high-level laboratory technicians, cost, etc.”

Regardless of the country or region, the challenges and needs in the food testing market are universal in many ways. “Food issues are global issues,” Mr. Chen and Mr. Lee stated. “[The] most [popular] analytes and MRLs in China are similar to the ones in US—with the harmonization of food regulations, the difference may be smaller in future.”

Companies Release Unique CRISPR Technologies

CRISPR gene editing technologies show great promise in accelerating research, development and manufacturing in many applications, such as biomedicine and food production. However, much more research is still needed before CRISPR platforms can be adopted and implemented in broader settings.

For example, last month, *Nature Methods* published a letter in which researchers discussed the issues they came across in their mouse study using CRISPR, namely the frequent off-target effects that were generated. The letter states that “[m]ore work may be needed to increase the fidelity of CRISPR/Cas9 with regard to off-target mutation generation before the CRISPR platform can be used without risk, especially in the clinical setting.”

Companies have been working to come up with new methods and technologies that can solve common issues with CRISPR and open up the technology to more applications. Horizon Discovery and MilliporeSigma both released innovative CRISPR platforms last month that aim to optimize CRISPR platforms and address some of the specific concerns that arise with gene editing.

Horizon Discovery's Helitron Transposon-based Technology

UK-based Horizon Discovery announced in May that it acquired the rights to use a Helitron transposon-based technology platform to build upon its existing gene editing capabilities. The technology platform was coinvented by Tilmann Buerckstuemmer, PhD, head of Innovation at Horizon Discovery.

Transposons are pieces of DNA that are able to "jump" from site to site within a genome. They play an important role in the removal and integration of genomic sequences, as their inherent capabilities support cell functions and aid in the creation of new genes. Helitron transposons are transposons that "capture and mobilize gene fragments in eukaryotes," according to a research paper published in *Nature Communications* in March 2016.

> ***"We are particularly excited about using this transposon for cell or gene therapy applications because it is cheap to manufacture and likely to deliver cargo at high efficiency."***

According to the company, Horizon's platform enables extremely efficient DNA delivery into a genome, making it a highly useful tool in applications such as cell engineering and therapy, as well as gene therapy. The Helitron-based platform enables a unique method of transferring and delivering DNA. While the majority of transposon-based platforms utilize a "cut and paste" mechanism to transfer DNA, Horizon's platform uses a "copy and paste" method, allowing users to integrate many copies of a single DNA sequence that are then incorporated into the genome. This makes the platform unique in its sequence and "mechanism of action," according to Dr. Buerckstuemmer.

This novel "copy and paste" mechanism enables the platform to be used for a variety of applications. "Horizon has full freedom to operate in all areas including cell products, services and therapeutics," he stated. "The copy and paste mechanism could be superior where particularly high levels of gene expression are needed and where the random integration of the transposon represents an acceptable safety risk."

Examples are the manufacturing of drugs, which can be costly and challenging, as well as manufacturing standards for cancer cells. The Helitron-based platform can be used as a more efficient and cost effective alternative. "The generation of cell lines that express high levels of biologicals (e.g. therapeutic antibodies) can potentially be obtained much quicker and at lower cost," explained Dr. Buerckstuemmer. "Another application relates to the manufacturing of reference standards for genomic amplifications such as Her2 that will be used to bench mark diagnostic tests for breast cancer."

While useful for many applications, the platform shows much promise in optimizing the manufacturing of cell and gene therapies due to its unique mechanism. "We are particularly excited about using this transposon for cell or gene therapy applications because it is cheap to manufacture and likely to deliver cargo at high efficiency [through its copy and paste function]," stated Dr. Buerckstuemmer. "Such characteristics are desirable, for instance, for approaches that re-wire T cells in cancer ([such as] CAR-T cell therapy)."

The technology is meant to complement existing CRISPR technologies and is part of a broader offering that Horizon is in the process of developing and in-licensing, according to Dr. Buerckstuemmer. "With this tool kit at hand, Horizon will be able to broaden its scope and utilize the right tool at the right time—depending on the specific application," he said.

While Horizon's Helitron transposon–based "cut and paste" mechanism boosts efficiency in gene editing by allowing for greater DNA transfer and delivery in CRISPR platforms, MilliporeSigma's recently developed technique increases efficiency by providing greater target specificity.

MilliporeSigma's Proximal CRISPR Technique

In MilliporeSigma's research paper on proximal CRISPR (proxy-CRISPR), published in *Nature Communications* in April, various CRISPR-Cas systems are discussed, including the hypothesis that type II-B FnCas9 from *Francisella novicida* has the "ability to access target sites in certain mammalian chromatin contexts." FnCas9, as used in the proxy-CRISPR technique, specifically helps with common CRISPR challenges, such as off-target effects, by requiring two CRISPR DNA binding events for cutting, making the proxy-CRISPR method much more target specific. "The requirement for two binding events doubles the size of the DNA target sequence, making it exponentially more unique," said Martha S. Rook, PhD, head of Gene Editing & Novel Modalities at MilliporeSigma.

The "two binding events" that Dr. Rook referred to relates to the proxy-CRISPR method, which requires the use of catalytically dead SpCas9 to bind to the DNA. By using two dead SpCas9, which are able to penetrate the chromatin in human cells, the FnCas9's nuclease activity is restored in the cell. If the FnCas9 was used on its own, its activity would be inhibited due to its inability to target the chromatin structures. This makes the proxy-CRISPR method much more efficient and specific than traditional CRISPR methods.

The *Nature* research paper also indicates that the same genomic sites in various genes can be "selectively modified" with proxy-CRISPR through using selected proximal dCas9-binding sites to distinguish the identical genomic sites. This enables the proxy-CRISPR method to be extremely useful in increasing the specificity in diseases for which genome editing can be quite complicated, such as blood diseases. "It is well known in the genome editing community that the genes involved in blood disease share high homology, meaning the DNA sequences are the same across many blood genes," explained Dr. Rook. "This creates challenges when gene therapy researchers want to target only one hemoglobin gene."

> ***"The requirement for two binding events doubles the size of the DNA target sequence, making it exponentially more unique."***

Citing the research in the *Nature* paper, Dr. Rook pointed out how proxy-CRISPR can target a specific site in a specific area. "Proxy-CRISPR, using dead-SpCas9 and active CjCas9, can be used to cut a site in only one location, Hemoglobin Subunit Beta (HBB), even when that exact DNA sequence also exists in Hemoglobin Subunit Delta (HBD)," she said. "[In this example,] there is some DNA sequence surrounding the CjCas9 target site, which is different between HBB and HBD, and dead-SpCas9 was targeted to only the HBB allele, allowing CjCas9 to cut only the HBB allele." This example illustrates how proxy-CRISPR can "improve specificity in challenging genome editing scenarios," she said.

Deciding what CRISPR-Cas system to use is largely driven by what the DNA sequence of a specific gene is. "Different diseases have different DNA sequence requirements," stated Dr. Rook. According to Dr. Rook, knowing what these DNA sequences require can only be predicted by examining the DNA sequences that are thought to play a major role in disease phenotypes, as opposed to solely examining the phenotypic nature of the disease itself. "Simply put, the greater the variety of DNA sequences you can target with CRISPR, the greater the number of diseases you can address," explained Dr. Rook. "Depending on the priority of efficacy vs specificity, the appropriate CRISPR combination can then be employed."

She added, "The great thing about proxy-CRISPR is that it increases the number of CRISPR systems that can be used, and thus the number of applicable DNA sequences and diseases." The proxy-CRISPR method is expected to open new gene editing opportunities for MilliporeSigma's customers, as well as the company's business partners and internal cell engineering R&D teams, according to Dr. Rook.

Anton Paar Ups Capabilities for Particle Characterization

Graz, Austria 6/6/17—Anton Paar, a developer of high-quality measurement instruments, has acquired the PSA line of particle-size analyzers from CILAS, a supplier of particle-characterization systems. Financial details were not disclosed. "The instruments from CILAS are internationally acknowledged quality instruments for the measurement of nanoparticles and microparticles and represent an excellent addition to our Litesizer product line," said Jakob

Santner, division manager of Anton Paar's Business Unit Characterization. "We now offer our customers measuring systems for an enormous measuring range. This begins with particles of the size of a single water molecule and ends with pebble-sized particles." Anton Paar commented that the acquisition expands its portfolio of particle sizing instruments based on dynamic light scattering, extends the size measurement range of its laser-based diffraction instruments and adds imaging analysis technology.

This purchase considerably expands Anton Paar's range of instruments for particle characterization, broadening the light scattering–based techniques it offers. The PSA line consists of four instruments. The main business of French firm CILAS, a subsidiary of Airbus, is lasers and optronics for military and industrial applications.

Providers of Lab Washers and Sterilizers Merge

Gütersloh, Germany/Briese Pio X, Italy 6/9/17—Miele has acquired a controlling stake in Steelco, growing its medical technology division by a third to €250 million ($277 million at €0.90 = $1) in annual revenues. Both companies offer cleaning, disinfection and sterilization products for the medical and laboratory markets. In 2016, Steelco recorded sales of €71 million ($79 million). "Together with Steelco, Miele can combine its claim to quality and innovation leadership with a significantly broader product portfolio, and hence expand its market position," stated Andreas Barduna, commercial director of Miele's Professional business. Miele will consolidate its central sterile supply department business, which serves hospitals, under the Steelco brand. Miele subsidiaries will handle customer-segment marketing for general surgeries, dental practices and labs. Steelco's founders and management will remain with the company.

Among the products supplied by Miele's Professional business are laboratory cleaning systems and washers for glassware and stainless steel. Steelco's laboratory products include lab washers and stream sterilizers. Both companies' products serve a variety of end-markets, with general laboratory offerings accounting for a small percentage of sales. Steelco has 400 employees. In fiscal 2016, Miele generated revenues of €3.71 billion ($4.1 billion).

Thermo Fisher Scientific's Clinical MS System Makes Its Debut

In the May 31 issue, ***IBO*** detailed Thermo Fisher Scientific's annual analyst day (see ***IBO*** *5/31/17*). At the event, the company revealed it was at work on a dedicated clinical MS system. This week, Thermo Fisher previewed the Thermo Scientific Cascadion SM Clinical Analyzer at the EuroMedLab conference. Calling it "the first all-in-one LC-MS/MS solution designed to meet the needs of clinical laboratories," the system is set to receive EU CE marking next year and will be released in the US once it is FDA approved as a Class I medical device.

Thermo Fisher also plans to launch three kits specifically designed for the system, following FDA 510(k) approval. The first kits will be for 25OH vitamin D, total testosterone and immunosuppressant drugs. Other kits are expected to follow and may include kits for drugs of abuse and endocrinology.

> ***"The instrument is pivotal to the system, but as essential are the additional items that we are designing, manufacturing and validating for use on the instrument."***

"There hasn't been [an LC-MS/MS] platform that's really designed specifically for the clinical lab," said Robert S DeWitte, PhD**,** vice president, Research and Development, and vice president, Clinical Mass Spectrometry, at Thermo Fisher, in an interview with ***IBO***. Dr. DeWitte emphasized the differences between how LC-MS/MS is currently used in some clinical labs but does not meet the needs of most clinical labs. "The clinical laboratories are really designed nowadays around turnaround time and single-piece flow, and the instruments themselves are all random-access instruments—that's the mainstream core chemistry lab."

Barriers to adoption of LC-MS/MS by clinical labs on which Thermo Fisher focused in developing the Cascadion SM were: regulatory, quality (e.g., variability from lab to lab), resources (e.g., operator skills) and workflow (e.g., turnaround time). “This system is comprehensive: sample in, result out. For mass spectrometry, that has not been done,” noted Dr. DeWitte. The integrated system, which resembles a standard clinical chemistry analyzer in size and appearance, consists of the automated Thermo Scientific TurboFlow online sample preparation technology, a newly designed LC based on the Prelude MD HPLC system, a newly designed MS system based on the TSQ Altis Triple Quadrupole MS, and dedicated software. Among the system’s innovations are a quick-connect cartridge and spring-loaded clamp for easy and fast changing of analytical columns. Another innovation is random-access loading, which reduced turnaround time in contrast with current LC/MS systems used for clinical applications that require sample batching.

“I really want to emphasize this is a system and not an instrument,” added Dr. DeWitte. “The instrument is pivotal to the system, but as essential are the additional items that we are designing, manufacturing and validating for use on the instrument.” These include reagents with internal standards, calibrating controls for each of the assays, a set of consumables (e.g., solvents) and disposables. “All of these materials are standardized. They all come prepared and ready to use from us,” he said, thus providing a standardized solution.

Although Dr. DeWitte said he could not comment on the performance requirements of the system, as it is pending regulatory approval, he did highlight the turnaround times as being on par with current clinical immunoassay systems, which is the primary technology competitor for LC/MS in hospital labs. “Immunoassay analyzers that are in the clinical core labs: the sort of performance they have are a time to result of 15–25 minutes for each sample. They are random-access immunoassay analyzers, and our cycles are right in line with those performance characteristics.”

Cascadion SM is a closed system, and therefore cannot be used with LDTs. Explaining the advantages of this, Dr. DeWitte said, “Getting to quality is all about variability. So a great amount of the design is taking variability out of the laboratory and moving it into the factory.” In this way, standardization is built into the entire solution, from calibration to software. For example, with Thermo Fisher developing and manufacturing the assays, knowing the sample types and using a fixed system design, the software can be standardized to meet the requirements of any clinical lab.

The Cascadion SM Clinical Analyzer will be featured at the annual American Association for Clinical Chemistry conference held in August, in San Diego, California.

Eppendorf's Software Investments

In the May 31 issue of ***IBO*** (see ***IBO*** *5/31/17*), we reported on Eppendorf’s acquisition of a majority stake in Bio-ITech, a provider of LIMS, ELNs and inventory sample management systems. Asked how Bio-ITech’s solutions differ from competing products, an Eppendorf spokesperson told ***IBO***, “The different applications offered by Bio-ITech consider all aspects to be covered within the lab workflows. The combination of the different products (ELN, LIMS, Sample Management) presents a platform that manages both workflows (SOPs, results, samples, stocks, etc.) and collaboration, while enhancing productivity.” As she noted, “This comprehensive solution approach differentiates Bio-ITech from other competitors.”

Eppendorf recently unveiled its VisioNize platform, which will be officially released in August. Utilizing both software and hardware components, the system enables networking of multiple Eppendorf instruments, such as new Eppendorf freezers, shakers and thermocyclers, for monitoring and data recording. Data can be compiled to detail a sample’s history. However, Bio-ITech was not part of the product’s development. “VisioNize has been developed by the Eppendorf competence centers, primarily by DASGIP Information and Process Technology GmbH in Jülich/Germany,” said the spokesperson. She added, “However, both offers, Bio-ITech applications and Eppendorf VisioNize system, complement each other perfectly.”

First Quarter Results: Danaher, Fluidigm, Hitachi, Merck KGaA, Pacific Biosciences

CY Q1 2017 Results								
	Revenues			Rev. Growth Summary			Adj. Operating Profit	
Company	Rev. (M)	% of Co. Rev.	Growth	Curr.	Acq./Div.	Org. Growth	(M)	% Growth
Danaher	$4,205.7	100%	7.0%	-2%	6%	3%	$623.9	1.8%
Fluidigm	$25.5	100%	-12.0%	0%	0%	-12%	-$14.6	9.4%
Hitachi High-Tech. (Sci. & Med. Sys.)	¥51,330	29%	3.3%	-4%*	6%*	1%*	¥5,300	-13%
Merck KGaA (Life Science)	€ 1,481.3	100%	6.1%	2%	0%	3.3%	€ 383.1	13.0%
Pacific Biosciences	$24.9	100%	30.3%	0%	0%	30%	-$22.0	0.7%

*Estimate

Click to enlarge

Danaher Reports Steady Q1 Growth

First quarter sales for Danaher's Life Sciences segment expanded 4.0%, 3% organically, to account for 31% of company revenues. Segment growth was driven by strong biopharmaceutical demand, especially in China. For the segment as a whole, equipment and consumables sales grew roughly 2.5% each. Consumables sales growth was reduced 50–75 basis points due to one fewer selling day.

SCIEX sales grew in the low single digits organically, as strength in China and Western Europe was partially offset by lower sales in North America, weak demand from clinical customers and one fewer selling day. By end-market, biopharmaceutical sales for the SCIEX business grew double digits, while applied sales were roughly flat despite strong food and environmental demand in China. On a standalone basis, sales for the acquired Phenomenex business (see ***IBO*** 10/15/16) climbed in the mid-single digits organically despite a strong comparison.

Sales for the Beckman Coulter Life Sciences (BCLS) business grew in the low single digits organically, led by continued strength in the Flow Cytometry and Particle Counting businesses, especially in China. However, BCLS growth was partially offset by lower demand for centrifugation products and slower demand in developed regions due to timing of projects.

Leica Microsystems sales grew in the high single digits organically, including growth across all product lines and geographic regions. With the exception of industrial markets, which experienced steady improvements, microscopy sales were higher in all other customer markets. Furthermore, microscopy sales were boosted by several new project wins within the confocal and surgical businesses in North America and Western Europe.

Selected Danaher Segments Q1 2017					
	Rev. (M)	Rev. Growth	Curr.	Acq./Div.	Org. Growth
Life Sciences	$1,308.1	4.0%	-1.5%	2.5%	3.0%
Environmental & Applied Solutions	$914.8	4.5%	-1.5%	1.5%	4.5%

Click to enlarge

Pall sales advanced in the low-single digits organically, including mid-single digit growth for the Pall Life Sciences business due to strong demand for single-use technologies from biopharmaceutical customers. Meanwhile, Pall Industrial sales declined slightly because of a strong comparison.

Operating margin for the Life Sciences segment jumped 210 basis points to 16.2% as a result of cost control and restructuring measures, acquisitions and productivity improvements.

For Danaher's Environmental & Applied Solutions segment, first quarter reported and organic sales expanded 4.5% each to account for 22% of revenues. Growth was driven by strong instrument sales and higher pricing, which contributed 0.5% to segment revenue growth. Organic sales for the water quality business and Hach grew in the

mid-single digits each. Hach sales were strong in China, and grew in both North America and Western Europe due to improved orders in the previous quarters. Conversely, Hach sales declined in both Latin America and the Middle East. Sales growth in the other businesses, including Product Identification, ultraviolet water disinfection and chemical treatment solutions, also contributed to segment growth. Environmental & Applied Solutions operating margin was flat at 22.7%

Fluidigm Stabilizes Cash Outflow in Spite of Depressed Sales

First quarter sales for Fluidigm contracted 12.0% to $25.5 million due to a projected decline in single-cell genomics sales. This regression was attributed to continued competitive challenges, and weakness in Asia Pacific and Europe. However, sequentially, company sales improved a modest 1.8%, representing a second consecutive quarter of sequential growth.

Overall, instrument sales fell 22.3% to account for 42% of revenues, primarily due to lower C1 sales, which slumped more than 70%. This was moderately offset by higher mass cytometry system sales. Despite improved demand for mass cytometry reagents, consumables sales contracted 8.5% to make up 41% of revenues. Propelled by post-warranty contracts, service revenue climbed 17.6% to represent 16% of revenues. License revenue, which declined, was negligible.

Fluidigm Q1 FY17			
	Rev. (M)	Rev. Growth	% of Rev.
Instruments	$10.7	-22.3%	42%
Consumables	$10.6	-8.5%	41%
Service	$4.2	17.6%	16%
License and Grant	$0.1	-33.7%	0%

Click to enlarge

Based on markets, genomics product sales tumbled 37.7% to $11.4 million. Mass cytometry product revenue jumped 39.4% to $9.9 million, including double digit-sales growth for both instruments and consumables. This growth was driven by demand for the new Imaging Mass Cytometer and strength in the biopharmaceutical markets. While the company will provide ongoing development and service efforts for C1 customers and the roughly 365 active systems, resources will be shifted to the faster growing NGS library preparation and qPCR markets.

Geographically, sales declined double digits in all major regions, falling 18.1%, 17.0% and 10.2% in Europe, Asia Pacific and the US, which accounted for 30%, 20% and 46% of revenues, respectively. Conversely, sales in Other regions more than doubled to account for 4% of revenues.

Adjusted Product gross margin fell 630 basis points to 62.2% due to lower production volume and product mix. Adjusted operating loss narrowed 9.4% to $14.6 million as a result of cost saving measures. The company reduced its cash outflow from $11.8 million in the fourth quarter of 2016 to $9.2 million in the first quarter, resulting in a cash balance of $50.3 million. Second quarter sales are projected to declined 15%–22% to $22–$24 million.

Hitachi High-Tech. Reports Mixed Fiscal Q4 Results

For the fiscal fourth quarter ending March 31, Hitachi High-Technologies' Science and Medical Systems (SMS) sales grew 3.2% to ¥51.3 billion ($451.3 million at ¥113.67 = $1) to account for 28% of company revenues. Excluding currency headwinds and acquisitions, SMS sales advanced roughly in the low single digits. Sales were particularly strong in the Biotechnology and Medical Products business, especially for clinical analyzers, as well as new gene and bacterial testing products. Higher sales of LC and MS products further contributed to growth. However, sales of electron microscopes were sharply lower due to weak academic and government spending in both Japan and Europe, as well as a strong year-over-year comparison. SMS operating margin contracted approximately 200 basis

points to 10.3% because of currency, product mix and increased investments.

Hitachi High-Technologies Science & Medical Systems FYE 2017				
	Q4		FY	
	Rev. (¥B)	Rev. Growth	Rev. (¥B)	Rev. Growth
Electron Microscopes	¥9.4	-23.1%	¥30.0	-14.0%
Scientific Instruments	¥7.6	-3.9%	¥23.4	-6.4%
Medical Products	¥30.0	12.2%	¥117.0	12.7%
Biotechnology Products & Other	¥4.4	51.7%	¥15.7	18.0%

Click to enlarge

For the fiscal year, SMS sales advanced 5.1% to ¥186.1 billion ($1.7 billion at ¥108.76 = $1) to make up 29% of revenues. Organic sales grew at a similar mid-single digit range, led by large orders for clinical analyzers and strength in China. Segment operating margin slipped 50 basis points to 14.5%.

For fiscal 2017, the company projected SMS sales to grow 2% to ¥190.5 billion ($1.8 billion at ¥105.00 = $1). Fiscal full-year sales of Scientific Instruments and Electron Microscopes are expected to grow 12% and 26%, respectively. Biotechnology Products and Others sales are estimated to climb 17%, while Medical Products sales are anticipated to fall 8%.

Merck KGaA Reports Modest Q1 Growth

First quarter sales for Merck KGaA's Life Science (LS) division grew 6.1%, 3.3% organically, to €1.48 billion ($1.58 billion at €0.94 = $1) to make up 38% of company revenues. Currency and the acquisition of BioControl Systems (see ***IBO*** 1/15/17), net of divestments, added 2.4% and 0.4% to sales growth, respectively.

Applied Solutions sales improved 4.4%, led by strong demand for food and beverage testing, as well as healthy growth in the lab water business. Sales for the Research Solution business advanced 1.0%, as growth in China and other higher-growth regions was partially offset by weakness in the US.

Process Solutions sales climbed 4.8% due to strength in upstream processing, especially for biopharmaceutical ingredients and single-use products. However, sales growth was hampered by a strong comparison and a slow start to the year.

Geographically, LS sales in Asia Pacific climbed 8.2%, with broad-based growth across most businesses, especially for upstream bioprocessing products and services in South Korea.

Merck KGaA Life Science Q1 FY17						
	Rev. (€M)	% of Rev.	% Rev. Growth	Currency	Acq./ Div.	Org. Growth
Research Solutions	€ 537.1	36%	3.2%	2.5%	0%	1.0%
Applied Solutions	€ 391.4	26%	9.1%	2.7%	2%	4.4%
Process Solutions	€ 552.8	37%	6.8%	2.1%	0%	4.8%

Click to enlarge

Sales in the Middle East & Africa region advanced 8.6% due to strength in both the Process and Research Solutions business. Latin American sales expanded 6.4% due to strength in the Biomonitoring and Advanced Analytical businesses. European sales grew 2.3%, led by strength in the Lab Separation and Workflow Tools businesses. North America sales improved 0.6%, as higher sales of analytical instrumental products from Applied customers were offset by lower demand within the Research Solutions business.

LS adjusted gross margin jumped 900 basis points to 59.0% due to sharply lower cost of sales, as the company accounted for increased inventories in the previous year following the completed acquisition of Sigma-Aldrich (see ***IBO*** 11/30/15). Adjusted operating margin advanced 160 basis points to 25.9%. The company maintained its 2017 outlook for LS organic sales to grow above the market rate.

Pacific Biosciences Cuts Outlook

Excluding Roche's contractual revenues of $3.6 million in the previous year, first quarter product and service sales for Pacific Biosciences climbed 60.4% to $21.3 million.

Instrument sales jumped 63% to $12.6 million, led by increased placements of Sequel systems, especially in China. The company placed a number of systems in China to both new and existing customers over the last two quarters, including 15 Sequel systems to just two Chinese customers during the same period. The company also highlighted increased demand from plant and animal sequencing markets. Overall, total installed instrumentation base reached more than 300 systems.

Pacific Biosciences Q1 FY17			
	Rev. (M)	% Rev. Growth	% of Rev.
Product	$21.3	72.0%	85%
Service and Other	$3.6	14.9%	15%

Click to enlarge

Consumable revenue advanced 88% to $8.7 million due to an expanded installed base of PacBio systems, which reached more than 300 units. The company also noted increased demand for SMRT Cell kits for plant and animal sequencing applications. Service and other revenue expanded 15% to $3.6 million.

Adjusted product and service gross margin advanced 307 basis points to 41.1% due to instrument mix and increased placements. Adjusted operating narrowed 0.7% to $22.0 million.

Despite positive sales momentum in the quarter, the company offered a cautious outlook for instrumentation sales due to delayed government funding in the US. As such, the company lowered its 2017 product and service revenue growth range from 40%–60% to 35%–45% to $105–$115 million. Second quarter sales are projected to be substantially higher on a year-over-year bases, but to decline sequentially.

NGS Single-Cell Library Preparation Kits

The generation of NGS libraries from single cells is growing in demand as the use of single-cell analysis broadens. The analysis and comparison of an individual cell against a population and against other individual cells allows researchers to implement different sequencing techniques in the fields of cancer, metagenomics, stem cells, developmental biology, immunology, neurobiology, drug discovery and almost any other area in biology. The detection of DNA mutations, CNVs, DNA–protein binding, RNA splicing and the measurement of mRNA expression gives researchers new insight into what is happening at a particular moment in an individual cell.

For the analysis of individual cells, the first step is to isolate them from suspension or tissues. This can be achieved by a variety of methods, such as FACS, serial dilutions, laser capture microdisection and microfluidics. The approach taken depends on the final objective and the resources available. Once the cells are isolated, sample preparation using the kits begins. Most of the kits' protocols consist of cell lysis, nucleic acid denaturation, neutralization, amplification, fragmentation, end-repair and platform-specific adaptors ligation. The amplification step, of critical importance, is typically done by PCR, but some brands have introduced PCR-free amplification based on methods such as multiple displacement amplification. If the target molecule is RNA, then reverse transcription is needed as

an additional step at the beginning.

Due to the novelty of single-cell library preparation techniques, there are only a handful of vendors that focus on single-cell library preparation kits. Among the kits available are QIAGEN's QIAseq FX Single Cell DNA and RNA Library Kits, Rubicon Genomics' PicoPLEX WGA Kit, Takara's SMART-Seq v4 Ultra Low Input RNA Kit, 10x Genomics' Single Cell 3' Reagent Kit, and the recently launched SureCell WTA 3′ Library Prep Kit from the partnership between Illumina and Bio-Rad Technologies. The two latter kits are substantially different from the other mentioned kits, as single-cell RNA libraries are barcoded as part of the protocol, which allows differentiation of unique reads for more accurate downstream analysis. The different kits have their advantages and disadvantages that need to be weighed according to the purpose of the experiment.

There are two fundamental technological challenges on which single-cell library preparation kit suppliers are focused: 1) the ability to work with the highest possible cell-capture capacity, and 2) the amplification of genetic material to yield sufficient material for downstream analyses while minimizing the introduction of artifacts, such as amplification bias, genome loss, mutations and chimeras.

The pharmaceutical and biotechnology sector is the most rapidly growing market for single-cell library preparation kits due to the exponential rise of NGS. Demand from this sector is expected to continue growing due to strong interest in companion diagnostics, biomarker discovery and cell-based applications.

Academic and government research facilities also account for a big portion of the market, as the decreasing cost of NGS instruments and the cost per analysis, along with the emerging flexible and comprehensive NGS systems entering the market, have paved the way for the use of systems in dedicated facilities for rapid single-cell DNA sequencing for identifying disease-causing mutation sequences. Single-cell library preparation is a rapidly growing market that is expected to see advances in clinical research settings in a few years.

NGS Single-Cell Library Preparation Kits at a Glance:

Leading Suppliers:

- QIAGEN
- Rubicon Genomics

Major markets:

- Academia
- Government Research
- Pharmaceutical and Biotech

Kit Cost (96 Reactions):

- $4,000–$6,000

Chemicals

Since Dow Chemical's acquisition of DuPont a year and a half ago, there has been an influx of M&A activity in the chemical industry. In 2016, deals to buy chemical companies that were announced or completed that year had an aggregate value of $263.7 billion, up 33.3% from 2015. The chemical industry has struggled to achieve strong demand since the 2010 recession, so the M&A activity is changing the dynamics of the entire industry. Due to weak demand, chemical companies are looking to purchase rival companies in a bid to reduce costs and drive up revenues, which will ultimately provide better contracts with both chemical suppliers and chemical customers.

Cutting costs is a major "deal driver" in the chemical industry, which has also lead to a spike in collaboration. For example, China has gone from importing chemicals to exporting them, which has caused commodity chemicals prices to fall, prompting more consolidation for greater profits. Another driver is the industry's need to match its suppliers (i.e., oil and gas) and customers (i.e., automotive, pharmaceutical), which include industries that tend to have greater consolidation. By increasing consolidation in the chemical industry, chemical companies carry greater

weight through the diversity of their commodities and services, and can therefore negotiate better deals with their customers and suppliers.

Notable deals within the last year and a half include ChemChina's $43 billion M&A proposal to buy Syngenta last February and Bayer's purchase of Monsanto for $66 billion in fall 2016.

Source: *Financial Times*

Government

Late last month, the Trump administration released its 2018 budget proposal, which indicates cutting indirect costs that the NIH makes to research institutions, as well as hospitals, to account for 10% of the total grant, a 66% decrease (see ***IBO*** 5/31/2017). In doing so, the current $4.6 billion spent on overhead costs, such as lab maintenance and regulation compliance, would be freed up and put towards research. This would also enable the administration to decrease the NIH budget by 22% with little affect on the NIH's direct science expenditures. The potentially diminished budget would greatly effect research institutions' abilities to conduct research, purchase equipment, maintain infrastructure and win grants. Although these budget cuts are not likely to be approved by Congress, the administration may still be able to decrease overhead payments to the agency.

Indirect cost payments have been added to research grants since 1947, and universities negotiate their own overhead rates (for both facilities and administration) with the government once every few years. These rates are dependent on geography, urbanization and field. On average, the NIH base rate for its grants is approximately 52%, which translates into $52,000 given to a university for overhead costs on a $100,000 grant. Universities have long voiced their concerns that these negotiated rates do not cover "true research costs."

The Trump administration's proposal states that a flat rate of 10% for indirect costs should be applied to all research institutions, which would cut NIH indirect costs expenditures by 71% from 2016, while direct spending would remain flat at around $17 billion in 2018. Universities have spoken out about this flat rate, as it would not cover enough of the institutions' overhead costs and would limit researchers in what grants they pursue.
Source: *Science*

Food

Food fraud remains a pressing issue in the agriculture industry, especially for foods marketed as "organic" or "USDA Organic," such as corn and soybeans. Most foods labeled "USDA Organic" are grown in the US, but roughly 50% of these organic-labeled foods come from up to 100 overseas countries. According to USDA guidelines, any company importing an organic product is required to prove that it has come from a supplier that is "USDA Organic" certified; however, companies are not required to trace the food back to the farm that it came from, which can lead to discrepancies within the classification of the food as "organic" or not. Some farms hire third-party inspection companies that give ample notice of their arrival, leaving no element of surprise to the inspection. Moreover, pesticide testing has yet to become a standard and requirement for the industry.

Labeling goods as "organic" without adequate proof can easily be done by the middleman companies involved in imported products, and the profit can be up to two times more than a non-organic-labeled product. The USDA has yet to take proper action on these products. Within the last few years, the amount of soybeans and organic corn imported into the US has more than tripled, but the USDA has yet to issue any major sanctions for importing fraudulent grains. The US is actually an extremely easy market to infiltrate with fraudulent grains and foods due to a lack of rigorous import rules, as in Canada and Europe. When the Agency receives complaints about potentially fraudulent products, its response is too slow and the products tend to reach consumers before any action is taken.

Testing for pesticide residue has proven that products imported to the US from many countries, such as China and Turkey, are not as organic as they are labeled to be. This indicates that the USDA is in need of streamlining the importation process and enforcing stricter pesticide testing laws.

Source: *The Washington Post*

Poland

In 2015, Poland's total Gross Expenditures on R&D (GERD) was €4.3 billion ($4.8 billion). The three sectors of R&D in Poland are the business sector, which in 2015 accounted for €1.5 billion ($1.7 billion), the public sector, which represented €1.7 billion ($2.0 billion) and foreign sources, which made up €516 million ($581.7 million). Poland's GERD target is 1.7% of GDP in 2020.

The federal government is the main funder of R&D in Poland, although its overall share of spending shrank after 2010, when the private sector and European Commission began to provide greater R&D funding. For example, in 2015, government budget appropriations for R&D decreased 35.4% to €1.3 billion ($1.5 billion). However, in 2015, the government increased the science budget by approximately 10% and a further 6% (compared to 2015) in 2016. The government also amended its "ineffective" tax incentives in early 2016, which placed a greater emphasis on technology acquisition instead of R&D.

Business Expenditures on R&D (BERD) have moderately increased since 2010, with manufacturing and services accounting for 95% of BERD from 2010 to 2012. Manufacturing in the automotive, electrical equipment and pharmaceuticals sectors are the chief drivers of Polish BERD. In recent years, Poland has developed a reputation of a supplier of business services, including services for clinical trials of new drugs. This has caused the offshoring and outsourcing sector in Poland to grow at a rate three times faster than that in India. Pharmaceutical companies such as Roche, AstraZeneca and Amgen are amongst the biggest BERD spenders in Poland.

Compared to 2010, the nation's total BERD increased 29 percentage points to 0.47% in 2015; however, Poland still lags behind the majority of EU member countries and even its fellow Central and Eastern European countries. This is thought to be due to a shortage of incentives for businesses to invest in R&D, which has also contributed to the lack of innovative R&D. However, although overall investments have been decreasing, they are expected to pick back up in 2017 when R&D projects co-funded by the EU will be implemented.

Source: *European Commission*

Japan

Japan has fallen behind Europe, the US and China in its publication of scientific articles and, therefore, its research output. Due to a stagnant science budget, R&D institutions are facing deficits and having difficulties in procuring talent. Although there was an 80% increase in global scientific research paper output between 2005 and 2010, Japan's share of research output increased only 14%, while China's share of research output during the same period of time was double that of Japan's (see ***IBO*** 4/15/2017). Research in certain fields, such as mathematics and astronomy, have been growing in Japan, but applied research fields, such as computer and material science, have remained stagnant. This may be due to the shortage of Japanese researchers working internationally, as well as the lack of collaborative research with international partners. Currently, Japan's coauthorship rate is 30%, approximately half of Britain and France.

Since 2000, Japan's science budget has remained mostly flat. The country's "operational expense grants," which are "funds to support national universities and national research and development agencies intended to cover the fundamental expenses involved in education and research," can be used by universities as they see fit; however, these grants have decreased by ¥100 billion ($909.5 million), roughly 10%, over the last decade, with some research institutions receiving just a few hundred thousand yen each year. These funds usually cover equipment and maintenance costs at research facilities, but without the funds, scientists are forced to close their labs and find research projects elsewhere.

To remedy this, Prime Minister Shinzo Abe announced last month plans to increase the country's science and technology budget in annual accretions to total ¥4.4 trillion ($40.0 billion) by 2020, a ¥900 billion ($8.2 billion), or

25.7%, increase from the current budget. Universities and research institutions are encouraged to look for funding from non-government sources, such as corporate and private investments, in order to lessen their dependence on federal funding. The Japanese government is also establishing new guidelines to increase collaboration between academic research institutions and industry to draw in public funding, which it hopes to increase to ¥300 billion ($2.4 billion) in the next decade.

Source: *The Japan News*

UK

In a surprising turn of events, the UK's general election earlier this month saw the Conservative government losing seats in the British parliament, leaving no government in majority. Although the way events will unfold is still unclear, this unexpected result suggests that the Brexit directive may not be as hard on science as previously thought. According to Paul Nightingale, deputy director of the Science Policy Research Unit at the University of Sussex, the election result implies that the UK may undergo a "softer" Brexit and maintain its position within EU funding science programs. The election result also suggests that the UK has lost a bit of its strength in negotiations with the EU, which were scheduled for June 19. Moreover, the result may also change the previous majority government's strict stance on restricting the number of foreign students by counting them as part of immigration quotas. Although things are currently uncertain, the general sentiment amongst scientists seems to be one of cautious optimism.

Source: *Nature*

LIMS Consulting Firm Acquired by Accenture

New York, NY 6/1/17—Professional services firm Accenture has agreed to acquire LabAnswer, a provider of consulting services for lab informatics technology, including LIMS and chromatography data systems. Financial details were not disclosed. Based in Texas and serving multiple industries, LabAnswer has 250 employees. Accenture plans to establish Accenture Scientific Informatics Services, which will combine LabAnswer's capabilities with Accenture's R&D informatics expertise to assist life science companies in capturing, managing, integrating and analyzing research data. "This acquisition is part of our strategy to be a leading provider of scientific and laboratory consulting and technology services to a variety of innovation-based industries," stated Kevin Julian, leader of Accenture's Life Sciences practice in North America. "By connecting these services to our existing capabilities, we will be able to help our clients improve their end-to-end R&D efficiency and decision-making."

Accenture's investment represents greater competition for lab data services in a broad array of industries. LabAnswer currently works with a number of major instrument firms, providing services such as installation, interfacing and maintenance. LabAnswer competes with other LIMS consulting companies, as well as companies that offer both LIMS products and consulting services.

Life Science Instruments

General Life Science Instrumentation

Company Announcements

In its 2016 10-K SEC filing, **Luminex** disclosed a total of 51 strategic partners with commercialized products utilizing xMAP technology that submitted royalties, 29 of which principally served the life science research market.

In May, **NanoString Technologies** appointed Elisha W. Finney, former executive vice president and CFO at **Varian Medical Systems**, to its Board.

Product Introductions

In May, **Tecan** introduced new options and configurations for its Infinite 200 PRO Series of multimode microplate readers. The 200 PRO Series is now available in 6 application-focused configurations, including 2 single and 4 multimode configurations for absorbance, luminescence and fluorescence detection.

PolyPico Technologies released the Acoustic Droplet Ejection–based PicoPRECISE, an ultra-low-volume dispensing instrument for applications such as drug discovery, POC diagnostics and stem cell printing. It provides pico- to nano-liter volume ranges.

Instruments for Nucleic Acid–based Analysis

Company Announcements

Molecular Diagnostics firm **SpeeDx** and **Thermo Fisher Scientific** announced in April an agreement under which SpeeDx will submit its ResistancePlus MG Test for **FDA** clearance upon validation for use with Thermo Fisher's Applied Biosystems 7500 Fast Dx Real-Time PCR System to detect the sexually transmitted infection M. genitalium.

In May, **Seegene** entered into a strategic collaboration relationship with **Thermo Fisher Scientific**. Seegene will file for **FDA** clearance of its Allplex diagnostic assay portfolio at the same time Thermo Fisher files for FDA clearance to run the assays on its QuantStudio 5 Real-Time PCR System. Seegene aims to submit 510(k) clearance by the end of 2018.

PositiveID announced in May the formation of a new subsidiary, **ExcitePCR**, to own and further develop its Firefly Dx real-time PCR breadboard prototype pathogen-detection system. The subsidiary was formed to provide greater flexibility for strategic partnerships and financing.

Product Introductions

Eppendorf announced in May the Mastercycler X50, which will be introduced worldwide in July. It features heating rates of 10°C/sec on average and the 2D-Gradient. It also features connectivity to Eppendorf's VisioNize software for instrument monitoring (see Endpoint).

In May, **Thermo Fisher Scientific** launched the affordable and easy-to-use Applied Biosystems SeqStudio Genetic Analyzer, a CE-based system for Sanger sequencing and fragment analysis. It features an all-in-one cartridge that combines the capillary array, polymer reservoir and anode buffer. It allows sequencing and fragment analysis runs on the same plate with changing consumables. It will be available in the second half of the year.

In June, **Bio-Rad Laboratories** released the CFX Maestro Software for its CFX Real-Time Instruments, calling it the only real-time PCR instrument software that integrates statistical analysis, data visualization and publication-oriented graphics production in one platform.

Instruments for Cell-based Analysis

Company Announcements

In May, the **EU**-backed **MetaCell** project received €2.5 million ($2.8 million) in funding to develop a physiologically relevant cell-based assay platform for studying metabolism in preclinical drug discovery and development. The consortium members are **Axiogenesis**, **BMG Labtech** and **Luxcel Biosciences**.

ACEA Biosciences announced in June a collaboration with **Memorial Sloan Kettering Cancer Center** to evaluate

a personalized ex vivo potency assay using cancer patients' malignant pleural effusions and its xCELLigence Real-Time Cell Analysis instrument to monitor destruction of cancer cells by a patient's own genetically modified CAR T cells.

FlowJo announced in June a strategic relationship with **Becton, Dickinson**. The companies will collaborate to offer the cloud-based FlowJo Envoy with the BD FACSymphony to enable researchers to improve their workflow, collaborations and data storage in the cloud, and share single-cell analysis data analysis in real time.

Also in June, **FlowJo** partnered with **Cytapex Bioinformatics** to provide bioinformatics consulting and services in combination with the FlowJo application. The companies will offer consulting services in flow cytometry data analysis, including the development of custom pipelines.

Product Introductions

Logos Biosystems released in May the new CELENA S Digital Imaging System for fluorescence, brightfield and phase-contrast imaging. It has an onstage incubator, as well as interchangeable objectives and LED filter cubes.

In May, **ACEA Biosciences** launched a multi-option optical configuration of its NovoCyte flow cytometer, which includes the new ACEA NovCyte 3005 three-laser system for detection of up to 17 parameters.

BioTek Instruments introduced in May the Cytation 1 Cell Imaging Multi-Mode Reader, an affordable automated digital quantitative microscopy system with multimode microplate detection. The digital microscopy mode includes fluorescence and high-contrast brightfield channels.

NanoCellect Biomedical announced in May the N1 Single Cell Dispenser for its WOLF Cell Sorter. The module will aid applications that require the sorting and dispensing of single cells in 96-well or 384-well plates. The dispenser utilizes disposable technology. The formal introduction is scheduled for later this year.

Beckman Coulter introduced in June the AQUIOS Designer Software for its ACQUIOS CL Flow Cytometer. The Software allows creation of customer-defined applications, in addition to the previously available predefined applications.

In May, **Genedata** released, as part of its Genedata Screener for Ion Channel Screening platform, a new solution for the automated analysis of automated patch clamp data. New features provide further in-depth characterization of compound effects on key ion channels. The solution was developed in collaboration with **AstraZeneca**.

Cytek Biosciences introduced in May the affordable Aurora flow cytometer, with capabilities for over 20 colors, using 3 excitation lasers and 50 channels.

Sales/Orders of Note

In May, **Fluidigm** announced that the **UK Medical Research Council's Consortium for Mass Cytometry**, consisting of research institutions, has acquired seven Helios mass cytometry systems.

Berkeley Lights announced in May the purchase of an additional Beacon OptoFluidic Platform by **Amgen**. Amgen collaborated with Berkeley Lights to develop the technology.

Berkeley Lights announced in June the delivery of a Beacon OptoFluidic platform to **GlaxoSmithKline** for cell line development. The initial application will be to select clones based on optimal growth rates and monoclonal antibody selection.

In June, **Phasefocus** announced the purchase of its Livecyte system by the **Francis Crick Institute** for quantitative label-free live-cell analysis.

Instruments for Protein-based Analysis

Company Announcements

In March, **RedShift BioAnalytics** closed an $11.0 million Series C Preferred Stock financing. The financing was co-led by **Waters** and **Technology Venture Partners**. RedShift BioAnalytics' instrument provides measurements of protein quantitation, structure, stability, aggregation and similarity.

Biotage announced in April that it won a 2011 patent dispute with **CEM**. Biotage had challenged the validity of claims in two patents filed by CEM in Europe and Japan relating to a method of microwave-assisted solid phase peptide synthesis. The Board of Appeals in Japan declared the broad claims invalid in 2016, and the European equivalent body revoked the CEM patent in 2016.

Product Introductions

In May, **Syngene** launched new options for its G:BOX automated multipurpose gel and blot imaging systems, including the option to add a full spectrum of blue, green, red and infra-red HI-LEDS and additional software features.

Syngene released in June the NuGenius+ gel imaging system, a cost effective system for generating images of stain-free protein gels, as well as DNA agarose and SDS-PAGE gels.

Gyros Protein Technologies introduced a new version of the Gyrolab Protein A Kit, featuring increased efficiency and throughput for quantification of residual Protein A ligands with 96 microstructures. The two ready-to-use versions, Native Protein A and MabSelect Sure, are designed for use with Gyrolab systems.

In May, **GE Healthcare Life Sciences** launched the Amersham Typhoon NIR Plus biomolecular imager for NIR multiplex detection. It features a 3-laser flexible configuration with 2 essential NIR channels, as well as a third visible laser channel. It can scan 9 microtiter plates simultaneously.

Liquid Chromatography

Company Announcements

Agilent Technologies in April gave Professor Dwight Stoll an Agilent Thought Leader Award in support of his research applying 2D-LC to biopharmaceutical analysis. He is an associate professor of analytical chemistry at **Gustavus Adolphus College** in Minnesota.

In May, **Waters** announced a comarketing agreement with **Wyatt Technology** to advance the analysis of synthetic polymers and biotherapeutic proteins using SEC by pairing their respective Waters ACQUITY APC System with the µDawn Multi Angle Light Scattering detector.

In June, **YMC America** announced that it plans to build a production site in Kyoto, Japan, for manufacturing LC products, including packing materials, preparative packed columns and other products. These products are currently manufactured in Ishikawa, Japan.

Product Introductions

YMC launched in April the YMC-Triart PEEK-lined column, suitable for the analysis of metal coordination compounds. It is available in 6 chemistries, 3 particle sizes, and pore sizes of 120 Å and 80 Å.

In May, **Phenomenex** introduced a new Luna Omega Polar C18 stationary phase, which is 100% aqueous stable, offered in 1.6 µm and 5 µm particles. The company also released the 100% aqueous-stable Luna Omega PS C18 with

mixed-mode selectivity.

Also in May, **Phenomenex** launched the Kinetex 2.6 µm Polar C18, the ninth selectivity in its Kinetex core-shell family, which offers dual polar/nonpolar selectivity. The new selectivity enhances polar/nonpolar retention compared to traditional alkyl phases.

In June, **Phenomenex** expanded its Lux chiral LC/SFC column family with new immobilized Lux 5 µm i-Amylose-1 and Lux 3 µm i-Amylose-1 media.

In June, **GE Healthcare Life Sciences** released the Superdex 30 Increase SEC column for small-scale preparative purification and analysis. It is comprised of smaller, more rigid beads with a narrower particle-size distribution and a higher selectivity, and delivers broad enantioselectivity._

In June, **Waters** launched the Waters nanoEase M/Z columns for microflow and nanoflow LC. The columns are designed for easy installation with reduced connection variability. They utilize ZenFit Connection Technology, which requires no tools and utilizes reusable fittings. Available in multiple bonded phases with sub-2 µm particles, the columns can be used for Waters' and third-party systems.

Surface Science

Company Announcements

In March, **Abberior Instruments** co-exclusively licensed rights to **Leica Microsystems'** light microscopy product portfolio. In return, Abberior co-exclusively licensed IP rights to Leica. The rights pertain to the use of high-resolution light microscopy known as nanoscopy.

In May, **Thermo Fisher Scientific** and **King Abdullah University of Science and Technology** (KAUST) opened the Electron Microscopy Center of Excellence at the KAUST campus in Thuwal, Saudi Arabia. It builds on the parties' long standing relationship. As part of the opening, KAUST commissioned the FEI Titan Themis Z S/TEM, the first such system to be installed worldwide. The center has already installed 16 microscopes from Thermo Fisher.

ZEISS Research & Technology sales for the fiscal half year, ending March 31, grew 3.3% to €743 million ($790 million) to make up 29% of total revenues (see ***IBO*** 5/15/17).

In May, **JPK Instruments** announced a collaboration with **Abberior Instruments**, a provider of super-resolution microscopes, involving its demonstration center in Berlin, Germany. The companies have launched a program to demonstrate the combined features of their respective NanoWizard AFMs and STEDYCON system. Abberior's STEYCON is a compact STED (STimulated Emission Depletion) combined with a confocal microscope.

The **Salk Institute's Waitt Advanced Biophotonics Center** and **ZEISS** announced in June a partnership agreement, enabling access to ZEISS technology before its commercial availability. Techniques that will be used include high-speed 4D fluorescence imaging, and cryo-correlative fluorescence and electron microscopy,

Product Introductions

In May, **ZEISS** announced ZEISS ZEN 2 core for imaging analysis and interactive control of microscopes. It is designed to connect systems, data, and workflow and features a single GUI.

Thermo Fisher Scientific introduced in May plasma FIB technology for its FEI Helios G4 DualBeam Series, which enables the analysis of a relevant set of features that are too large for conventional gallium FIB. It is available in two models: the CXe with a flexible 110 mm DC stage and the UXe with a high-performance 150 mm piezo stage.

In May, **Oxford Instruments** launched Symmetry, calling it the world's first CMO-based EBSD detector. It features an acquisition speed in excess of 3,000 indexed patterns per second, which will open up new applications in fields such as in situ experiments, and the study of bio- and nanocrystalline materials.

Leica Microsystems debuted in May the DMi8 S live-cell imaging solution. It features the Synapse real-time controller for faster data acquisition and the LAS X Navigator for visualizing all types of samples. The system's modular Infinity Port architecture enables the addition of fluorescence capabilities with the Infinity TIRF for executing simultaneous multicolor EPI, Hi-Lo and TIRF illumination, as well as high-powered illumination options for super-resolution applications. The Infinity Scanner photomanipulation scanner also can be added to take advantage of the latest developments in photoactivatable and photo-switchable fluorescent proteins.

Hitachi High-Technologies introduced in May the Regulus series of FE-SEM, comprising four models. The Regulus8100 (resolution down to 1.1 nm) is the successor to the SU8010, and the Regulus8220, Regulus 8230 and Regulus8240 (resolution down to 0.9 nm) extend the function of the SU8200 series with the use of a common platform. The systems feature enhanced functionality, improved resolution and operability, and a new cold FEG for improved resolution. Sales are forecast to be 300 annually.

In May, **JEOL** launched the NEOARM (JEM-ARM200F) TEM, featuring the new ASCOR (Advanced STEM Corrector) spherical aberration corrector that compensates for higher-order aberrations. It features a cold FEG and a new STEM detector for enhanced contrast of light elements.

JEOL also released in May the JEM-1400Flash TEM, which is equipped with a high-sensitivity CMOS camera, an ultra-wide-area montage system and a new sample exchange system. It also has an optical microscope–image linkage function, which allows a digital image from an optical microscope to be overlaid onto a TEM image.

In June, **JEOL USA** introduced the JSM-7900F FE-SEM, a flexible, easy-to-use instrument. It features the new NeoEngine electron optical system and the new Smile Navi navigation system.

Olympus launched in June the redesigned BX53 biological microscope, featuring a new high-luminosity LED. The redesign includes easier operation, with the integrated Light Intensity Manager and a new 40X objective lens.

In June, **Park Systems** released the affordable Park NX12, an inverted optical microscope–based SPM platform for scanning ion-conductance microscopy, scanning electrochemical microscopy and scanning electrochemical cell microscopy. The system combines a NX10 base with NX-Bio's XY stage that mounts on an inverted optical microscope. It offers ease of use in both air and liquid, and a platform for pipette-based SPM techniques.

Sales/Orders of Note

In June, **TESCAN** announced the installation of its first high-resolution FIB-SEM in Southeast Asia, with a TESCAN GAIA3 placed at **Fabrinet**'s Thailand facilities. Fabrinet is a manufacturer of components and modules for optical communication systems, as well as industrial lasers and sensors.

Informatics

Company Announcements

Labsis Laborsysteme, a provider of rack/microplate-based data reduction and data management software, announced in January the acquisition of **Mikrotek Laborsysteme**, which supplies microplate data reduction software and database systems.

In March, **Aeroblaze Laboratory** partnered with **LIMSey** to provide an online portal for managing testing jobs.

Simulations Plus announced in April a distribution agreement with **Electrolab India**.

In May, **BC Platforms**, a provider of genomic data management solutions, closed a $10 million financing round, led by **Debiopharm Innovation** and **Tesi**.

ELN firm **LabArchives** integrated its system with **Microsoft** Office Online. The company has 180,000 users of its software.

SolveBio announced the integration of its Pathway Studio Pathway Viewer software with **Elsevier**'s database of biological molecular interactions and curated pathways.

In May, **John Wiley and Sons** partnered with **CAS**, a division of the **American Chemical Society**, for predictive synthesis, which will integrate the ChemPlanner cheminformatics software with CAS's reaction content and associated references. New features include stereoselective retrosynthetic prediction. The latest version of ChemPlanner will be delivered exclusively in SciFinder.

Optibrium announced in May a collaboration with **Imperial College London** and the nonprofit **Drugs for Neglected Diseases Initiative** for drug development for neglected diseases.

In June, simulations and modeling software firm **Simulations Plus** agreed to purchase **DILIsym Services** for $10 million in cash and a possible earn out of up to $5 million. DILIsym Services provides products for simulation of drug-induced liver injury. DILIsym generated 2016 revenue of just over $3 million.

Product Introductions

In April, **Autoscribe Informatics** introduced the Field Analytics System for its Matrix Gemini LIMS. It allows for test data to be recorded off-line and uploaded when an Internet connection is available.

Brooks Life Science Systems released in May the BioStudies biobank data management system, which is integrated with **MicroStrategy**'s enterprise analytics and mobility software. It features visualization and dashboard capabilities.

In May, **PerkinElmer** launched PerkinElmer Signals Lead Discovery for searching, aggregating and analyzing internal and external data sources.

In June, **TIBCO** introduced the TIBCO Spotfire Data Catalog, a data connectivity and management solution for automatically finding and relating structured and unstructured data. It is part of **PerkinElmer**'s Signals platform.

FlowJo released in May FlowJo Envoy, a cloud environment for coordinating multi-omic workflows for flow cytometry and gene expression.

Sales/Orders of Note

In April, **ResearchSpace** and **Lab-Ally** announced the adoption of their RSpace ELN by **Mass Innovation Labs**, an incubator for scientific start-ups.

In May, **Goldfinch Bio**, a precision therapy developer, signed a multi-year license agreement for **Optibrium**'s StarDrop software.

Certara announced in May the Phase I unit at **Peking Union Medical College Hospital's Clinical Pharmacology Research Center** will deploy its Simcyp Population-based Simulator to develop physiologically based PBPK models in support of drug applications.

Reported Financial Results

$US	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Enzo Biochem	Q3	30-Apr	$27.1	2.5%	($0.2)	91.0%	($0.1)	96.6%
Enzo Biochem (Life Sciences)	Q3	30-Apr	$7.5	-9.3%	$0.6	-31.7%	NA	NA
Roka Bioscience	Q1	31-Mar	$2.0	25.3%	($7.3)	6.0%	($7.6)	7.0%
Other Currencies								
Halma	FYE	31-Mar	£961.7	19.0%	£167.1	16.9%	£129.7	19.2%
Halma (Environmental & Analysis)	FYE	31-Mar	£219.1	16.0%	£35.1	15.4%	NA	NA
Horizon Discovery	FYE	31-Dec	£24.1	19.4%	-£12.4	-20.2%	-£11.4	-15.7%
Eurocontrol Technics	Q1	31-Mar	CAD 0.6	85.1%	(CAD 1.6)	13.2%	(CAD 1.4)	NM
Jiangsu Skyray Instrument	FYE	31-Dec	CNY 430.4	33.9%	CNY 39.3	11.4%	CNY 55.7	22.7%
Jiangsu Skyray Instrument	Q1	31-Mar	CNY 116.5	35.7%	CNY 16.3	22.8%	CNY 17.6	21.0%
Olympus (Science Solutions)	Q4	31-Mar	¥29,947	6.6%	¥4,006	37.5%	NA	NA
Olympus (Science Solutions)	FYE	31-Mar	¥93,227	-8.2%	¥5,280	-37.8%	NA	NA
Oxford Instruments	FYE	31-Mar	£348.5	9.0%	-£20.0	NM	-£20.3	NM
Oxford Instruments (NanoTechnology)	FYE	31-Mar	£208.6	11.4%	£25.6	20.2%	NA	NA
Oxford Instruments (Industrial)	FYE	31-Mar	£56.7	5.0%	£1.7	54.5%	NA	NA
Oxford Instruments (Service)	FYE	31-Mar	£83.2	6.1%	£15.2	-19.1%	NA	NA
Porvair	FYE	30-Nov	£109.4	14.1%	£10.7	8.9%	£7.7	11.2%
Porvair (Microfiltration)	FYE	30-Nov	£74.6	15.1%	£11.8	22.1%	NA	NA

NA = Not Available, NM = Not Meaningful