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Instrument Business Outlook

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The 2017 IBO Design Awards: Instrument Giants Get Compact

Every August, ***IBO*** conducts its annual Design Awards, a competition recognizing innovative and bold industrial design of analytical instruments. While technical features and performance are the cornerstone of any instrument's functionality, the ***IBO*** Design Awards are based on the physical appearance, aesthetics and design features of the product, which are key in influencing purchasing decisions, as well as brand perception and product loyalty. To

qualify for the Awards, the instrument must have begun shipping between August 1, 2016 and July 31, 2017.

The winners of ***IBO***'s 2017 Design Awards for analytical instruments showcase innovation in size, shape and style, with compact footprints and modernist designs. Each winner is unique in its respective technology category, with distinctive features and improved usability complementing instrument performance.

Gold Award

The 2017 winner of the ***IBO*** Gold Award for Industrial Design for analytical instruments is the **Phytronix Luxon Ion Source**, a laser diode thermal desorption ion source. Using fiber-coupled laser diode technology to obtain thermal uniformity, the Luxon is Phytronix's second generation sample introduction and ionization source. The new design completely reimagines the simple square design of the first generation product, adding curved lines, and the contemporary look and feel of the latest high tech consumer product.

The Luxon has an adjustable height between 50 in and 71 in (127 cm and 180 cm), with a width and depth of 17 in (43 cm) and 18.5 in (47 cm), respectively. Completely new features to the second generation system include an adjustable base, wheels for mobile transport, handles for easy adjustment, and a glossy finish with color accents

Working in collaboration with design firm Tak Design, Phytronix has revolutionized traditional ion source designs, presenting an eye catching and completely unique looking ion source. As Jean Lacoursière, president of Phytronix, told ***IBO***, "The base on the wheels gives an incredible facility to move, connect and disconnect the instrument on a mass spectrometer." This ease-of-use-feature allows researchers to move the Luxon comfortably around the lab, increasing time savings and efficiency. The mobility enhances its usefulness for various sectors of research, such as pharmaceutical, bioanalytical, food, forensic and environmental. The Luxon provides continuous operation. Supporting fast analysis of samples, with speeds of one second per sample and uninterrupted throughput is an automated liquid handling and robotic transfer arm and, on top, the integrated LazWell plate stacker, with barcoding for traceability of samples and low-volume delivery of 0.1–10 µl or 0.05–2.5 µl for the Luxon-960 and Luxon-3840 models, respectively.

Click to enlarge

According to Mr. Lacoursière, modularity and ergonomics were the main technical, physical and aesthetic priorities

for the Luxon's industrial design. The easily accessible base container of the Luxon can be used for storage, and the neck provides ergonomic support for adjusting the height, with three memory settings for use with various MS instruments. The electronic control unit fastens to the ergonomic support, and researchers can attach the compact ion source to the electronic control unit, or use it as a freestanding ion source.

It was necessary for the technology of the instrument to be reflected in a bold design. "The Luxon Ion Source is the fastest process in mass spectrometry," said Mr. Lacoursière. "[So] the design must be ultra-modern." Ensuring ease of use was also important to provide greater efficiency in labs, thus the Luxon is a plug-and-play, easy-to-install instrument, providing direct sample introduction that avoids carry-over and memory effects.

With its sheer innovation and unique design of the ionization source, Phytronix has singlehandedly stepped up the design game for MS ion sources.

Silver Award

Illumina's **NovaSeq 6000** is this year's winner of the ***IBO*** Silver Award for Industrial Design for analytical instruments. The NovaSeq 6000 is part of the new NovaSeq series, which is the most powerful sequencer Illumina has released, able to sequence between 3 and 48 human whole genomes in each run. The NovaSeq measures 31.5 in (80 cm) × 37.2 in (94.5 cm) × 66.0 in (167.6 cm), including the monitor, and weighs 1,059 lb (481 kg), including a 7.8 lb (3.5 kg) leak tray, and the 2 lb (0.9 kg) keyboard and mouse.

With the NovaSeq 6000, Ilumina breaks with the design motif of its iconic NGS systems, presenting a floor standing configuration and simplified exterior appearance reminiscent of clinical lab instrumentation. With a modern and compact design, the system emphasizes ease of use, such as the reduction in hands-on time. Although smaller in size than the company's flagship HiSeq systems, the Novasep adds new capabilities, such as onboard cluster generation.

In addition, although the system is more compact, it provides greater flexibility, including greater scalability for high-throughput genomics research. "The NovaSeq series of sequencing systems expands NGS possibilities for all researchers," said an Illumina spokesperson. "With unmatched scalable throughput, tremendous flexibility to support a range of applications and streamlined operation, the NovaSeq 5000 and NovaSeq 6000 Systems are the most powerful high-throughput Illumina sequencing systems to date, perfectly positioned to help users uncover more about the genome than ever before."

Click to enlarge

Illumina worked with an undisclosed design firm to develop the NovaSeq, and the result is an approachable and unified design for labs of all kinds. Among the system's integrated features are a single cartridge for both reagents and buffers, a centrally mounted touchscreen, and on-board waste-bottle storage. As opposed to the company's HiSeq series, which was larger and had a more stacked-module appearance, the NovaSeq 6000 has rounded corners and balanced lines for a sleek finish, with a design that intuitively communicates its self-contained features and ability to fit in labs of virtually any size.

There were many design priorities for the NovaSeq. "The slab was a huge aesthetic component," Illumina told ***IBO***. "Other elements were the French doors, keyboard tray, white monitor and finished interior. There were physical priorities such as needing to fit through doors in old labs and cargo holds on typical commercial planes." The silver midpoint and top guides user interaction, while the lighted LED display visually communicates flow cell status.

The new instrument design not only reflects the NovaSeq 6000's flagship status but the evolution of Illumina's NGS system into an integrated, routine lab instrument for a wide range of applications. In this way, the system's appearance and industrial design help tell a larger story.

Bronze Award

The 2017 Bronze winner for ***IBO***'s Design Awards is **Shimadzu**'s **PDA-MF** series of optical emission spectrometers (OES), which includes the PDA-MF and PDA-MF Plus. The company's very first benchtop OES, the PDA-MF series provides rapid elemental analysis of solid metallic samples. The PDA-MF measures 23 in (58 cm) x 28 in (71 cm) x 21 in (53 cm), and weighs 143 lb (65 kg).

The PDA-MF series was developed in-house at Shimadzu's Corporate Product Design Center. As benchtop systems, the PDA-MF series is much smaller than previous PDA OES models, boasting a bold black-and-silver color scheme and a smooth, rounded front for enhanced usability and a more compact appearance.

However, these features are not simply for aesthetic reasons, but also support the system's functionality and users' practical needs. "We designed the front in a round shape so users wouldn't feel undue pressure when standing or moving in front of the instrument," said Shinya Hasebe from Shimadzu's Corporate Product Design Center. "When investigating this application, we discovered that users move frequently in front of instruments. So we wanted to ensure the shape of the PDA-MF does not impede a user's workflow."

Moreover, as metals analysis is the primary application for the PDA-MF, the slick black color was cleverly chosen more for pragmatism than for edginess. "[W]e designed the table and maintenance section to be black because these systems are often installed in dirty environments, and we didn't want dirt to be noticeable," explained Mr. Hasebe.

Click to enlarge

According to Mr. Hasebe, simplicity and intuitiveness were a priority for the instrument's design. "The main consideration was ease of use, with a primary focus on physical usability," he said. "Also, the excitation table shape helps create a smoother workflow; its cover-plate can be easily opened without removing the table or using any special tools, which enables simpler routine maintenance."

The PDA-MF makes sample analysis extremely simple. "[W]ith this system, a user can easily and precisely affix a sample to the sample holder, after which it is analyzed," said Mr. Hasebe. "The analysis result gets displayed in an easy-to-understand user interface. Perhaps the most appropriate way to describe the PDA-MF is that it was designed and developed to reduce analysis complexity while retaining functionality." As Mr. Hasebe told ***IBO***, the sample holder was specially designed to ensure precise measurements of any sample size. "As a whole, these concepts simplify use," he said.

With its thoughtful design, and its juxtaposition of usability with clean aesthetics, Shimadzu's PDA-MF is an exciting addition to OES industrial design.

SCIEX Diagnostics Discusses Its New Clinical LC/MS System

The Topaz System (see MS and NGS Play Bigger Roles at AACC 2017) is SCIEX Diagnostics' first major milestone,

according to Aaron Hudson, PhD, senior director of SCIEX's Clinical Diagnostics Business. SCIEX Diagnostics was formed to focus on the high-growth clinical MS market, and built upon the foundation of that business within SCIEX. Discussing the history of SCIEX Diagnostics, Dr. Hudson told ***IBO***, "We needed a team of people that were just focusing 24-7 on the clinical market. Two-and-half years ago, we introduced SCIEX Diagnostics. SCIEX Diagnostics is an incubator within SCIEX, and we've got our own structure within SCIEX Diagnostics. There are about 40 people within it just focused on the clinical market."

The Topaz is specifically designed for hospital labs. "[I]n the US, you've got reference labs, like Quest, ARUP [and] LabCorp, that test a lot of samples sent out from hospitals. The same hospital labs would really like to adopt mass spectrometry, but it's a little bit difficult to do so because it's just too complicated," he explained. "Also, to bring a mass spectrometer in, even if it's a Class I medical device, they've got no assays to put on it, and it would take them probably six months to even validate that system in the lab, never mind develop an LDT." Most triple quadrupole MS vendors provide MS Class I medical devices.

> ***"They not only start to generate revenue on it to pay off the mass spectrometer, but they also are not paying to send it out to the reference labs as well,"***

In contrast, the Topaz is a Class II medical device when used with SCIEX's recently introduced FDA-cleared Vitamin D assay kit for the assessment of adult patients for Vitamin D sufficiency. As Dr. Hudson said, "Now, you can actually buy the system and add the Vitamin D assay on top of it, and lock down the system." Advantages of the Class II system and regulated assay include faster validation. "It takes around a month to validate that in the lab, so much quicker implementation. That's similar to what it would take to validate an immunoassay analyzer, so [labs] are fairly used to this. Within a month, they can start to get reimbursement dollars because they run Vitamin D."

The financial return extends beyond the set-up time. Regarding the labs, Dr. Hudson said, "They not only start to generate revenue from [the test] to pay off the mass spectrometer, but they also are not paying to send it out to the reference labs as well." As he told ***IBO***, the system's ability to run both the Vitamin D assay and LDTs offer more revenue opportunities. "Most big labs are getting between 150 and 200 Vitamin D assays per day. And even if you just get about 60–70, this [mass spec] pays for itself within 2 to 3 years. Now, in addition to that, what you can do is add your own LDTs on it, because this Topaz system is a locked system if you want to run Vitamin D, but it's open by design so that you can add additional LDTs on it." This also allows for the modification of assays, as he explained. "So if new markers come along and it's a closed system, tough. But now, if you have Topaz, you can do your own LDT and you can add it."

Future plans for the system include automation. "Because this is a batch system as well, you can prep your sample during the day—it's manual at the moment but we're going to launch an automated sample prep [system] at the beginning of next year—you can prep it during the day and just run it overnight," said Dr. Hudson.

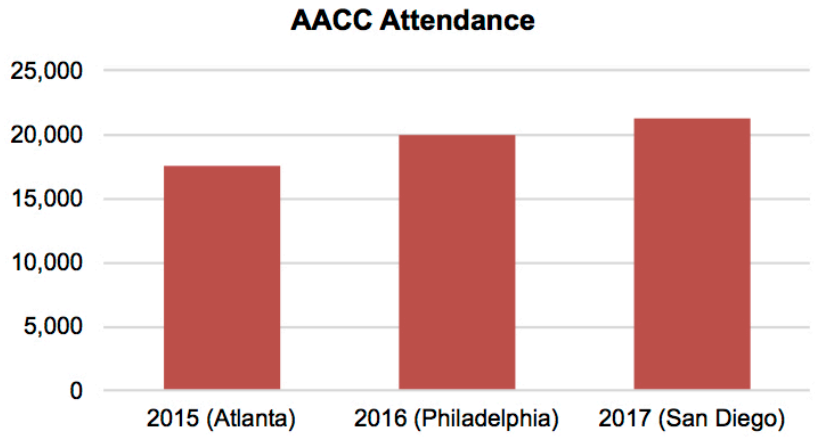
> ***So with the new markers coming out, if you're actually discovering those on a mass spectrometer, it's much easier to transfer them to a mass spectrometer test in the future."***

Rather than a 510(k) approval based on equivalence to an existing test, the FDA approval of the new Vitamin D assay was de novo. "As we went through this with the FDA, it became clear that the immunoassay wasn't really a predicate because when you look at the Vitamin D that the mass spec does, Vitamin D is actually a mixture of multiple analytes," he explained. "The immunoassay really only measures Vitamin D3. . . . Our mass spectrometer and Vitamin D method individually quantitates D2 and D3, and separates out the epimers, so you get a much more accurate measure of total Vitamin D." All subsequent MS-based Vitamin D tests for the same indication submitted for FDA approval will have to show equivalence to SCIEX Diagnostics' test.

The future opportunities for MS-based diagnostic testing are promising, according to Dr. Hudson. "When you look to the future of precision medicine, there's going to be a whole set of new markers coming out, either with proteomics, metabolomics [or] lipidomics. . . . So with the new markers coming out, if you're actually discovering those on a mass spectrometer, it's much easier to transfer them to a mass spectrometer test in the future." Yet MS will not be the solution in all cases. "I think the future, and precision medicine, is most likely going to be relying on mass spec detection, but I think it is going to be complementary to some of the existing technologies. It's not going to completely replace immunoassays or routine chemistries—it doesn't need to."

MS and NGS Play Bigger Roles at AACC 2017

The American Association of Clinical Chemistry's (AACC) 69th Annual Scientific Meeting and & Clinical Lab Expo took place July 30–August 3 in San Diego, California. The show's attendance rose 7.9% to over 21,300. The exhibition hosted over 750 exhibitors (see table below).



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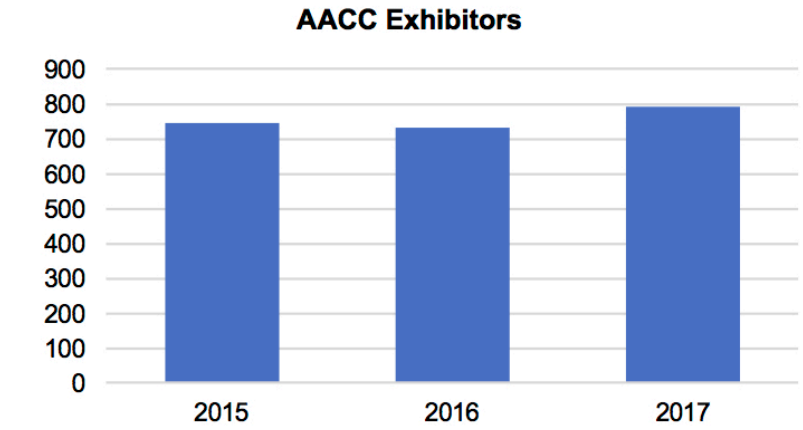
Among the exhibitors were leading triple quadruople MS companies, including Agilent Technologies, SCIEX, Shimadzu, Thermo Fisher Scientific and Waters. Although Bruker was not at the show, bioMérieux, another MALDI-TOF firm serving the clinical market, exhibited.



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At the show, SCIEX formally launched the SCIEX Topaz System, an LC/MS system for clinical diagnostics, and the integrated ClearCore MD software (see SCIEX Diagnostics Discusses Its New Clinical LC/MS System). It follows the company's May launch of the first FDA-approved Vitamin D 200M assay for quantitative determination of total 25-hydroxyvitamin D through measurements of 25-hydroxyvitamin D3 and D2 in human serum. The test is designed for exclusive use on the Topaz System for assessment of adult patients for Vitamin D sufficiency. The Topaz, a Class II medical device, also runs LDTs. The system's ClearCore MD software is a completely new platform designed for non-MS experts.

As a sign of the increasing competition in clinical MS, but taking a closed system approach, Thermo Fisher Scientific was also at the show, providing demonstrations of the Thermo Scientific Cascadion SM Clinical Analyzer (see ***IBO*** 6/15/17). Consumables for the system include specialized pipettes, LC cartridges and special sample tubes for sample preparation automation. The system is expected to be commercialized next year with kits to follow.

Waters showcased its Class I MS systems at the show. The company sells three versions of its tandem quadrupole MS systems in the clinical market. The company's 510(k) approved MassTrak Immunosuppressant Kit for monitoring tacrolimus via MS was introduced in 2007. For the European market, the company offers the CE-marked MassTrak Vitamin D Solution, and MassTrak Immunosuppressants XE Kit for quantifying tacrolimus and everolimus, in addition to the MassTrak Immunosuppressant Kit. Waters also provides both IVD and research columns for the systems, as well as sample preparation kits and reference materials.

The clinical MS market also includes PerkinElmer, which provides kits for neonatal screening. Linh Hoang, vice president of Neonatal Screening at PerkinElmer, told ***IBO*** that the company screens more than 39 million babies per year. The business is expanding in China, where more than 90% of newborns are now screened. The opportunity is also growing in India. "Newborn screening pilot programs in the public sector (using PerkinElmer instrumentation and kits) have demonstrated the value of newborn screening," he said. PerkinElmer provides the testing as a service at its clinical labs in Suzhou, China and Chennai, India.

Although not the focus of the show, NGS and MS were represented in the program. In a Tuesday morning session, "Beyond Sequencing: New Frontiers in Genomics," Jay Shendure, MD, PhD, of the University of Washington, Seattle, discussed his lab's work in using DNA barcodes in single-cells to create an organism development tree for zebrafish. As part of the work, the lab is also exploring how cell types are related to one another. Dr. Shendure noted that the main challenge for single-cell analysis is isolating cells.

A Tuesday afternoon symposia focused on MALDI-TOF in the clinic. Entitled "MALDI-TOF Mass Spectrometry: Not Just for Clinical Microbiology Labs Anymore," it was standing room–only for a presentation by Mari DeMarco, PhD, of the University of British Columbia. In her talk, she discussed the use of MALDI-TOF for epitope mapping to determine immunoassay reactivity. The research was conducted based on the testing of a patient for AdrenoCorticoTropic Hormone (ACTH) levels. Using immuno-MALDI-TOF MS, Dr. DeMarco mapped the epitopes of the ACTH present in the patient to determine the two antibodies in a Roche immunoassay kit to which they bind. The characterization of the ACTH fragment mixtures were used to distinguish the antibody's binding site and develop an internal standard for LC/MS/MS. She ultimately characterized the plasma ACHT-ome, identifying discrepancies in how the immunoassay worked. As she told the audience, "Don't be scared of MALDI-TOF."

In the second presentation, Tony Y. Hu, PhD, of Arizona State University discussed the use of MALDI-TOF to quantitate protein biomarkers using nanoparticles. He highlighted the advantages of MALDI-TOF, including speed, ease of use, high throughput and high sensitivity. His research targets the development of diagnostic tests for TB based on biomarkers. Specifically, he has created nanopore silicon porous particles to detect MTb-specific antigen markers in blood samples.

Present at the show were a number of vendors known for their research tools that are now growing their diagnostics businesses, including Abcam, Bio-Techne, Promega and TTP. Speaking with ***IBO***, Abcam discussed its expanding business for providing antibodies for clinical applications, especially companion diagnostics. The company is partnering with pharmaceutical companies to develop both custom antibodies and antibodies that are subsequently commercialized, such as anti-PD-L1 primary antibody [28-8] and others. Other clinical applications for the company's antibodies include clinical trials.

AACC 2018 will be held July 29–August 2 in Chicago, Illinois.

NanoString Finds Partner for Sequencer Development

Seattle, WA and Fremont, CA 8/8/17—NanoString Technologies, a provider of life science tools for translational research and molecular diagnostics, has entered into a strategic collaboration agreement with Lam Research to develop its Hyb & Seq single-molecule sequencing platform for clinical applications. Publicly held Lam Research is a supplier of wafer fabrication equipment and services to the semiconductor industry. NanoString will provide its sequencing chemistry and Lam will supply its nanoscale manufacturing expertise.

As part of the arrangement, Lam will contribute $50 million as well as receive a warrant to purchase one million shares of NanoString at $16.75 per share, in addition to royalties on the product. NanoString will commercialize the system, and the companies will share ownership rights of the joint IP. “By combining our Hyb & Seq technology with Lam’s advanced engineering expertise, we intend to fully resource the development of the industry’s simplest clinical sequencer, and enable open-ended innovation at the intersection of semiconductors and genomics,” stated NanoString President and CEO Brad Gray. The companies plan to launch a beta product in 2019, with a formal product launch in 2020.

Asked about why the company did not partner with a diagnostics company, a NanoString spokesperson told **IBO**, *“It’s an engineering and design project, not something that we thought a diagnostic company could add value to. We chose to collaborate with Lam based on their industry-leading nanoscale technology, and expertise in chemistry, fluidics and advanced systems engineering.” The development is now fully financed due to the collaboration, according to NanoString’s quarterly conference call.*

Benefits of the Hyb & Seq technology, according to NanoString, are a four-step workflow with no library preparation, enzymes or amplification required; a 60 minute turnaround from FFPE to the beginning of sequencing, including 15 minutes hands-on time; simultaneous sequencing of RNA and DNA; and the ability to produce both short and long reads. Commenting on read lengths, NanoString told **IBO**, *“In an early prototype version of our Hyb & Seq platform, we’ve demonstrated read lengths as long as 33 kb, and there is no theoretical upper limit to how long a read length could be possible once the chemistry has been optimized.”*

Bruker Acquires X-ray Spectroscopy Firm

Berlin, Germany 8/7/17—Scientific instrument firm Bruker has purchased Italian company XGLab for an undisclosed amount. XGLab provides x-ray spectrometry and x-ray imaging systems, as well as x-ray and gamma radiation detection electronics. “Their instruments perfectly fit into our portfolio of handheld and mobile spectrometers for elemental analysis and imaging, and will allow us to serve our customers in many application fields even better, particularly in art and conservation, and materials research,” commented Bruker Nano Analytics (BNA) Division President Thomas Schuelein. “In addition, XGLab’s expertise in detector electronics and customized spectrometers will enhance our technology base and help us drive further innovation in x-ray detection and analysis.” XGLab will maintain is name and management. (For information about the small spot XRF market, see Market Profile.)

Asked about the product overlap, Mr. Schuelein told ***IBO****, “There is actually very little overlap of XGLab’s products with the current product lines of the Bruker Nano Analytics (BNA) Division. Much rather XGLab’s portable analytical instruments, namely the ELIO portable small spot XRF analyzer, the CRONO macro XRF scanner, and the XRAMAN portable combined XRF and Raman analyzer, are fully complementary to BNA’s portfolio of handheld and portable XRF analyzers, closing the current gap (in terms of price/performance) between the TITAN and TRACER 5i handheld XRF analyzers and the higher-end micro XRF analyzers ARTAX and M6 JETSTREAM.”*

Regarding the company’s detector electronics and customized spectrometers, he commented, XGLab has deep knowledge and experience in the design of advanced electronic components for radiation detection and related signal processing, as well as in the design and production of complete, customized x- and gamma ray spectrometers. Electronic components include innovative Application Specific Integrated Circuits (ASICs), such as the unique CMOS-based CUBE preamplifier for SDDs, or the VERDI versatile single or multi-channel readout solution for different types of radiation detectors, e.g., SDD, scintillation detectors, photomultipliers and others.

He told ***IBO*** *that XGLab currently has 14 employees. Bruker signed a distribution agreement with XGLab in 2015 for the portable ELIO XRF system for art conservation applications (see* **IBO** *6/15/15).*

Busch Continues Its Pursuit of Pfeiffer Vacuum

Asslar, Germany 8/7/17; Asslar, Germany 8/7/17; Maulburg, Germany 8/7/17—The chairman of vacuum solutions

firm Pfeiffer Vacuum Technology, Dr. Michael Oltmanns, has announced his plans to retire in October. The announcement comes the same day as a proposal by Pangea, part of vacuum maker Busch, to call an extraordinary shareholders meeting to recall him and Supervisory Board member Dr. Wolfgang Lust. In June, Pfeiffer Vacuum shareholders rejected a tender offer by Pangea to acquire the firm (see ***IBO*** 6/15/17)**.** As Pfeiffer Vacuum's biggest shareholder, Busch owns more than 30% of the company.

Busch is proposing Pangea CEO Ayla Busch and former chairman Wolfgang Dondorf as new Supervisory Board members. "The economic self-interests as well as the missing impartiality and professionalism of Dr. Oltmanns as chairman of the Supervisory Board were demonstrated during the takeover process and particularly at the last annual general meeting," stated Ms. Busch, who is a managing partner of Busch. At the extraordinary shareholders meeting, Pangea is also calling for a vote to appoint a special auditor to examine the Board's conduct during the takeover offers, the use of the law firm Menold Bezler during the first voluntary takeover and Pfeiffer Vacuum's recent acquisition of Nor-Cal Products.

Pfeiffer Vacuum is supplier of vacuum products for analytical instrumentation, as well as an MS vendor for gas analysis. According to Bloomberg, Dr. Oltmanns is a partner at Menold Bezler, but claimed no conflict of interest. On August 3, Pfeiffer Vacuum's share price closed up 1.5% at €141.20 ($168.10 at €0.84 = $1). Pangea's last offer was €110.00 per share ($1.31). Pfeiffer acquired Nor-Cal Products, a manufacturer of premium-quality vacuum components, chambers and valves, in June for $68 million.

Second Quarter Results: Bruker, Illumina, PerkinElmer, Thermo Fisher Scientific and Waters

CY Q2 2017 Results								
	Revenues			Rev. Growth Summary			Adj. Operating Profit	
Company	Rev. ($M)	% of Co. Rev.	Growth	Curr.	Acq./Div.	Org. Growth	($M)	% Growth
Bruker Scientific Instruments	$362.5	87%	4.8%	-2%	5%	4.4%	$30.5	61.4%
Illumina	$662.4	100%	10.0%	0%	0%	10%	$147.0	-9.8%
PerkinElmer	$547.0	100%	2.0%	-1%	2%	1%	$99.6	5.8%
Thermo Fisher Scientific	$4,990.0	100%	10.0%	-1%	8%	4%	$1,162.4	23.3%
Waters	$558.3	100%	4.0%	-1%	0%	3%	$153.8	1.4%

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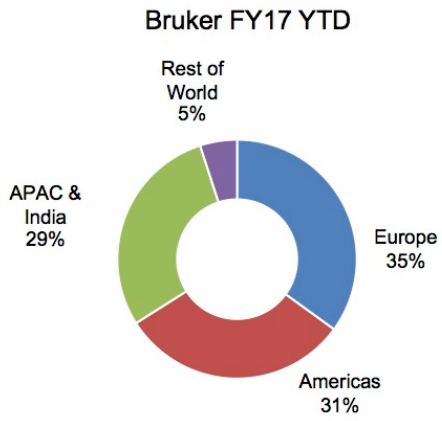
Bruker Delivers Strong Second Quarter

Second quarter sales for Bruker advanced 11.6% to reach $414.9 million (see Bottom Line). Bruker's revenues for the quarter grew 7.6% organically due to growth in its BioSpin, CALID and BEST Groups. The acquisitions of B-OST (Oxford Instruments Superconducting Wire), Hysitron and InVivo contributed 5.8% to revenue growth. Bruker's adjusted operating profit rose 61.4% due to an increased gross profit and operating margin. Adjusted operating margin grew 170 basis points to 12.5%, while adjusted gross margin contracted 100 basis points to 2.1%.

Geographically, in constant currency, Bruker's European sales rose in the high single digits due in part to acquisitions; North American sales grew in the low single digits, with improvement in academic orders; while Asia-Pacific organic revenues increased nearly 20%, largely driven by a strong performance in China.



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Bruker Scientific Instruments' (BSI) revenue grew 4.8% to $362.5 million to account for 87% of total revenues. BSI System sales grew 7.7%, and Aftermarket sales increased 4.8%, accounting for 72% and 28% of the segment revenue, respectively.

Bruker Q2 FY17						
	Rev. ($M)	% of Rev.	% Rev. Growth	Currency	Acq./ Div.	Org. Growth
Bruker Scientific Instruments	$362.5	87%	4.8%	-1.0%	5.8%	7.6%

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Within BSI, BioSpin's organic revenue rose mid-single digits driven in part by sales of low-field NMR systems. Preclinical imaging sales were higher as well. BioSpin's aftermarket and service businesses also continued their expansion. However, BioSpin no longer expects to record sales from a 1 GHz NMR system this year, as installation has been delayed to mid-2018. The Group reported stronger academic and industrial markets

Similarly, the CALID Group experienced stronger academic and industrial demand. CALID Group's revenue grew in the mid-teens on an organic basis, led by sales of the rapifleX MALDI MS, in addition to solid demand for the Biotyper MALDI MS, as well as consumables and service. In the first half of the year, Daltonics' sales increased in the low single digits in constant currency, but the Detection business declined due to a strong year-over-year comparison. The Group's Optics first-half revenues grew in the mid-single digits, as the business reported strong applied and industrial demand. Lastly, InVivo, a consumables company acquired earlier this year (see ***IBO*** 1/15/17), provided modest revenue growth for the quarter.

Bruker NANO's quarterly revenue declined on an organic basis, as semiconductor metrology revenue declined. However, Bruker expects a strong recovery in semiconductor metrology revenue for the rest of 2017. The segment's AXS business, having recovered from a difficult 2016 with noticeably higher margins, also posted higher revenue growth.

For 2017, the company raised its revenue growth forecast to 4.5%–6%, including organic revenue growth of 1.5%–2%, versus its previous guidance of 2%–3.5%. Bruker expects its revenue from acquisitions to add about 3.5%–4% to full-year growth.

Illumina Surpasses Forecast

Second quarter sales for Illumina outperformed expectations, increasing 10.4% to $662.4 million (see Bottom Line). The strong performance was led by higher-than-expected sequencing consumables and microarrays sales growth. However, adjusted operating income declined 10.3% to $146.6 million due to lower gross margins, and higher R&D

and SG&A expenses.

Illumina Q2 FY17			
	Rev. ($M)	% Rev. Growth	% of Rev.
Consumables	$402	6%	61%
Instrument	$136	8%	20%
Other Products	$5	0%	1%
Service & Other	$119	32%	18%

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Chinese sales showed the fastest growth, up 15% due to NovaSeq, HiSeq X consumables and NextSeq NIPT sales. Not far behind, European revenues rose 15%. Europe's strong sales growth came primarily from an increase in sequencing consumables sales. Asia-Pacific revenue rose 12%, although Japan remained weak. Sales in the Americas increased 8%.

By end-market, oncology represented more than 20% of shipment growth, led by commercial molecular diagnostic and liquid biopsy demand.

During the quarter, Illumina tripled its NovaSeq manufacturing capacity compared to the first quarter, allowing shipping and installation of around 80 instruments. NovaSeq orders also exceeded expectations, outdoing the company's forecast by 30%. The backlog stands at over 100 systems. Consequently, previous systems such as HiSeq experienced a decline in sales, with around 30 HiSeq systems no longer part of the installed base.

Total NovaSeq orders since its launch in January totaled 230. About two-thirds of NovaSeq orders came from HiSeq and HiSeq X labs, and around one-third were from new-to-sequencing and benchtop-only customers. The new-to-sequencing and benchtop customers represented around half of NextSeq, MiniSeq and MiSeq shipments. Overall, consumer customers led order growth.

Microarray revenue, including services, increased 16% to around $110 million. Microarray service and other revenue increased 32.2% to $119 million, driven by the consumer market.

Instrument revenues increased 7.9% to $136 million, primarily due to higher shipments of NovaSeq. Sequencing instrument sales grew 9%, reaching $130 million.

Revenues for the Consumables segment grew 6.1% to $402 million to account for 61% of total revenues. Sequencing consumables sales grew 9% to $338 million, while sales of microarray consumables declined 7%. Sales of HiSeq consumables revenue decreased sequentially. However, HiSeq X consumables experienced increased sales growth as utilization gains increased in China and liquid biopsy studies increased. Similarly, NextSeq consumables experienced strong revenue growth, as customers continue to standardize on the system into their production environments.

Service and Other revenue increased 32.2% to $119 million, driven by increased sales of genotyping services and instrument service contracts. Service and Other revenue grew 93%.

For 2017, Illumina has updated its revenue projection from 10%–12% to approximately 12% based on first-half results. The company expects a continued decline in the HiSeq and HiSeq X placements. For the third quarter, Illumina expects to expand its manufacturing capacity in order to ship even more NovaSeqs. The company expects NovaSeq margins to improve over the next four to six quarters.

PerkinElmer Faces Challenges

Second quarter revenues for PerkinElmer reached $547.0 million, a 2.0% increase (see Bottom Line), but were

below company expectations due to a weaker-than-expected academic market outside the US and a malware attack on one of its third-party logistics providers in Europe. On an organic basis, sales grew 1%. Together, these factors reduced organic sales growth by around 200 basis points, evenly divided between the two business units. Adjusted operating income advanced 5.8% to $99.6 million, leaving the company with an 18.2% operating margin, a 70 basis points increase.

PerkinElmer Q2 FY17						
	Rev. ($M)	% of Rev.	% Rev. Growth	Currency	Acq./ Div.	Org. Growth
Discovery & Analytical Solutions	$383.1	70%	0.4%	-1%	0%	1%
Diagnostics	$163.8	30%	6%	-1%	6%	1%

Click to enlarge

Geographically, the Americas' organic sales grew in the mid-single digits. In Europe, organic sales decreased in the low-single digits due to weak academic and government sales growth. Due to a strong year-over-year comparison, revenue in Asia was flat. BRIC countries recorded a revenue increase in the low teens, with Chinese revenue up in double digits.

Discovery & Analytical Solutions (DAS) revenue growth was modest, growing 0.4% to $383.1 million, or 70% of total revenues. However, the segment's sales growth was partially offset by unfavorable impacts from foreign currency, and a weak academic and government market in Europe and Asia. Organic revenue for the segment advanced 1%, while adjusted operating income increased 6.6% to $64.0 million. The segment's steady sales performance came primarily from mid-teens growth for the laboratory services business, especially from pharmaceutical and biotech customers.

By end-market, industrial sales growth increased around 2%–3%, driven by Asia. Academic and government sales were down low single digits but in the US increased in the high single digits. However, academic sales declined in Europe and Asia. Pharmaceutical and biotech revenue growth was up in the low single digits, driven by lab services. The service business's annual revenues totaled approximately $600 million. Environmental revenue increased in the low single digits, as sales of the company's new ICP-MS system added to sales growth. However, food sales declined due to a year-over-year comparison.

Diagnostics sales advanced 5.9% to $163.8 million to account for 30% of total revenue. Segment organic revenue increased 1%, and adjusted operating income grew 3.2% to $48.8 million. Additionally, the segment experienced a sales increase from its continued expansion in the newborn and infectious disease screening businesses. Newborn testing revenue rose in the high single digits.

For the third quarter, PerkinElmer expects organic revenue to grow around 5%, and reported revenue to range between $550 and $555 million. The company raised its full-year revenue guidance to $2.23–$2.24 billion, from its previous guidance of $2.20–$2.22 billion due to more positive foreign exchange effects and acquisitions. On an organic basis, the forecast for revenue growth remained at 4%.

Thermo Fisher Scientific Sales Benefit from FEI

Thermo Fisher Scientific reported a strong second quarter performance, with revenues climbing 10.0% to $4.99 billion. The company's organic revenue grew by 4%, while acquisitions increased revenue by 8%, supported primarily by recently acquired FEI (see ***IBO*** 1/31/16) and strong sales growth. Foreign currency translations reduced revenue growth by 1%.

Thermo Fisher Scientific Q2 FY17				
	Rev. ($M)	% Rev. Growth	% of Total Rev.	% Organic Growth
Life Science Solutions	$1,404.6	2.7%	27%	3%
Analytical Instruments	$1,165.8	46.8%	22%	6%
Specialty Diagnostics	$861.8	1.2%	16%	2%
Laboratory Products & Services	$1,792.5	4.2%	34%	5%

Click to enlarge

The pharmaceutical and biotech markets continued to be a strength for Thermo Fisher, as sales climbed mid-single digits. In the industrial and applied markets, revenues grew modestly at about the company average. In the second quarter, Thermo Fisher reported a continued increase in demand in its research and safety market channel from its industrial consumers, while experiencing a revival in its chemical analysis business. Bookings in the industrial market increased, as well as long and short-cycle revenues. In the applied market, environmental and food safety revenue growth remained solid, matching expectations. Revenue in the academic and government markets grew in the low-single digits, as did the sales in the diagnostics and healthcare markets.

The company saw strong performances across all product lines, with especially strong growth in biosciences, chromatography and MS. Bioproduction grew reasonably, yet growth slowed down compared to the last few quarters.

Geographically, North American sales grew at the company average, while sales in Asia-Pacific grew in the high-single digits range. In particular, China experienced strong revenue growth, increasing more than 15%. Much of the sales growth from China came from strong pharmaceutical, biotech and life science research sales, as well as the applied, healthcare and diagnostics markets. India, similarly, experienced a mid-teen increase. However, in Europe, sales growth was moderate, increasing in the low single digits. As for the Rest of World, revenue growth was flat.

Sales for the Life Science Solutions segment grew 2.7% to reach $1.4 billion, making it the second largest segment of Thermo Fisher, led by the biosciences business. The Life Science Solutions segment grew organically by approximately 3%. The microarray and eBiosciences businesses both saw strong growth.

With the acquired FEI business now fully integrated, the Analytical Instruments segment's revenues jumped 46.8% to $1.17 billion. Organically, sales grew 6%. The strong organic growth in the segment was driven by positive sales for the chromatography and MS businesses, while the overall segment growth emerged from the success of the electron microscopy business, including Cryo-EM sales. The electron microscopy business reported solid sales as FEI's Cryo-EM systems continue to perform well, with strong growth in revenues and bookings. In the materials science business, including semiconductors and applications for electron microscopy, revenue growth was strong.

In Thermo Fisher's Specialty Diagnostics segment, sales grew a 1.2% to $862 million, placing the segment in last place among total segment revenue growth. Organic revenue increased by 2%, as the segment's transplant diagnostics business delivered healthy revenue growth.

The Laboratory Products & Services segment represented the largest proportion of revenue for the company, increasing by 4.2% to reach $1.79 billion. Similarly, the segment's organic growth increased 5%. The segment's growth came from its strong channel business, biopharma services and clinical trials business. Moreover, the channel business was very strong globally, but especially in the US and in Europe.

For 2017, Thermo Fisher raised its guidance to reflect its substantial growth in the second quarter. The company upgraded its revenue guidance to $19.71–$19.89 billion versus its previous $19.51–$19.71 billion range, signifying an 8%–9% increase. Thermo Fisher continues to expect organic growth of 4% for 2017.. Lastly, the company expects its acquisitions to contribute just slightly under 5% to sales growth for the year.

Thermo Fisher expects the Asia-Pacific region to continue its strong performance for the rest of the year, with sales in China again increasing in the mid-to-high double digits. In Europe, the company expects its performance to stay on track with its guidance of just below the company average.

Industrial Gains Continue for Waters

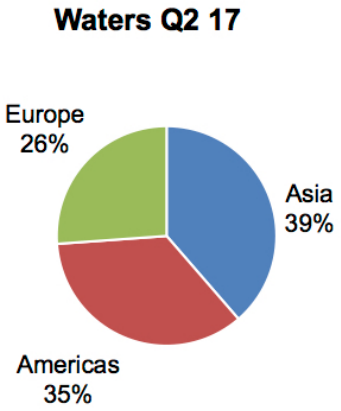
Waters second quarter sales grew 4.0%, reaching $558.2 million. Foreign currency translation reduced sales growth by 1%. Organically, revenues grew 3%. Waters' adjusted operating income increased 7.2% to $167.2 million due to higher sales volume and reduced costs.

Product sales grew steadily as recurring revenues, and sales of LC/MS and thermal analysis systems increased. The pharmaceutical and industrial markets lifted company sales growth, while a moderate governmental and academic market partially affected gains.

Waters Q2 FY17			
	Rev. ($M)	% Rev. Growth	% of Total Rev.
Waters Div.	**$497.8**	**4.0%**	**89%**
Instrument Systems	$238.6	2.9%	43%
Chemistry	$90.8	4.3%	16%
Service	$168.4	5.4%	30%
TA	**$60.5**	**4.6%**	**11%**
Instrument Systems	$43.5	6.7%	8%
Service	$17.0	-0.5%	3%

Click to enlarge

Geographically, Asia represented the largest revenue generator, with sales ascending 13.3% to account for 39% of total company revenues. Sales in China rose 18.0% to make up 44% of Asian revenue, led by industrial sales, as well as solid demand from pharmaceutical customers. In constant currency, sales in China and India each grew double digits. In Japan, sales increased 4.7%, also driven by the pharmaceutical, government and academic markets. In Europe, sales increased by 1.8%, including negative currency effects of 3%. Conversely, sales in the US slid 2.3% due to slower demand in the pharmaceutical and industrial markets.



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Instrument sales grew 3.3% for the quarter, while recurring revenue rose 4.6% to make up 51% and 49% of revenues, respectively. Instrument sales and recurring revenues sales growth were offset by foreign currency translation, reducing sales by 1% and 2%, respectively.

In the pharmaceutical market, sales increased 3%. However, sales growth was offset by 1% foreign currency translations. In the industrial market, sales grew 5%, or 7% in constant currency. Revenue in the government and academic market was up 7%, but grew 5% in constant currency.

Waters Instrument Systems sales grew 3% in constant currency, led by strong demand for the ACQUITY Arc HPLC, QDa MS, and IMS Q-Tof MS systems, as well as other LC and MS systems. ACQUITY Arc continued to show strong revenue growth, and LC/MS systems, such as Xevo TQ-XS and Xevo TQ-S, also showed a solid increase. Waters' chemistry consumables sales increased by 4%, due to the rise in demand for application-specific testing kits. For the Waters division, Japanese revenue grew 4%. In Europe, sales increased by 2% for the quarter. In contrast, sales in the US decreased by 3%, and sales for the rest of the world declined 9%.

TA's total sales grew 4.6%, with a 2% increase from recent acquisitions, resulting in organic growth of approximately 3%. TA Instrument Systems sales expanded 6.7%, 6% in constant currency, led by the company's recently introduced Discovery product line. In Asia, TA's total sales increased 17%, with the largest portion of sales in China and India. Japanese revenue growth was also significant, leaping 17%. In Europe, TA sales declined 3%. Sales also declined in the US falling 2%. In the rest of the world, TA sales rose 18%.

For the third quarter, Waters expects constant currency sales growth in the mid-single digits. For the full year, Waters forecasts sales growth of 5%–6%, with a 1% reduction in growth due to currency effects. As for gross margins, Waters expects a full year growth range of 58.5% to 59%, on track with its previous guidance.

Microspot X-ray Fluorescence

X-Ray Fluorescence (XRF) is a common technique for elemental analysis, and it can often be used with a minimum of sample preparation, making it suitable for a broad range of applications from inspection and QC to research. In XRF, a source of x-rays irradiates the sample. The x-rays are absorbed by some of the electrons in the sample and then ejected from the atom due to the increase in energy. When other electrons fill the gap in the electron structure, the quantum transition results in the emission of x-rays of a particular wavelength corresponding to each element. These are detected, and the strength of the fluorescence signal from each component reveals the relative concentration of each element in the sample.

The x-rays only penetrate the sample surface to a certain depth, so the technique is sensitive to surface composition. If the sample is heterogeneous, then bulk composition measurements might involve milling the sample to make it homogeneous. However, sometimes the analytical interest is precisely on the heterogeneous nature of the sample. It is in this situation that microspot XRF can be particularly advantageous.

In microspot XRF, the x-ray optics are designed so that the source focuses the x-rays into a small spot on the sample surface. Most instruments can produce a spot with a diameter of about a millimeter, and many have the option to focus it down more narrowly with a diameter of a few tens of microns. In this way, the x-ray spot can be aimed directly toward a point of interest on the sample, whether that is a component on a printed circuit board, or a particular mineral or inclusion in a geological sample.

Thus, the instrument can provide the elemental composition of just the target location. More sophisticated instruments can be programmed to analyze multiple spots along a linear scan to build up a fuller map of the composition across the sample. Another product differentiator is the atmospheric conditions of analysis; higher-end systems provide gas purges or vacuum systems to improve light-element performance.

Rather than determining composition, another specific application is the analysis of the thickness of surface layers that may be deposited on semiconductor materials, finished metals or other materials. In this case, if the sample composition is known, the detected x-ray information can be used to determine the thickness of one or more layers by gauging the intensity of the signal from each component of the layers.

Microspot XRF can be applied to just about any sample, but the strongest source of demand comes from the semiconductor and electronic industry. It can be used for thickness measurements of thin films, and other treatments of silicon wafers and additional materials. Completed circuit boards or other electronic devices can be examined for the composition of individual components, furthering compliance with regulations that cover the use of hazardous substances in these products. More broadly, the existence of hazardous substances can be tested across many consumer products from toys to clothing.

The metals and mining industry also has numerous applications for microspot XRF. Coating or plating thickness of

finished metals is a common application, and many instruments are designed with libraries to quickly identify alloys. An interesting subset of these applications is the identification and grading of precious metals. More research-oriented applications also exist. Geological samples can be analyzed, with the focus on individual mineral grains within a complex sample. Other uses can be found in environmental testing, forensics, battery research, and art and archeology.

The market leader is Hitachi High-Technologies. The company has long been involved in this technology, but the April announcement of its acquisition of the Industrial Analysis business from Oxford Instruments (see ***IBO*** 4/30/17) has propelled Hitachi into the top position in the marketplace. AMETEK also has a strong presence in this market, with contributions from both its SPECTRO Analytical and EDAX businesses. SPECTRO recently released a precious metals version of its Midex product line, the Midex MID05.

Bruker is the third most significant vendor, and is one of the few to offer a specific instrument for the art and archeology market. This month, the firm expanded its microspot XRF product line with the acquisition of XGLab (see Executive Briefing). PANalytical (Spectris) also competes in this market, and in July released a new small spot version of its Epsilon 1 analyzer. In March, Shimadzu introduced a kit to allow small spot analysis on its EDX-7000 and EDX-8000 analyzers. Other market participants include Fischer, ISP, Quantum, Skyray, Thermo Fisher Scientific and Xenemetrix. The total market demand for microspot XRF was approximately $200 million in 2016.

Microspot XRF at a Glance:

Leading Suppliers:

- Hitachi High-Technologies
- AMETEK
- Bruker

Largest Markets:

- Semiconductors and Electronics
- Metals
- Geology

Instrument Cost:

- $20,000–$250,000

Agilent Comments on Sequencing IP

In the July 31 issue, IBO reported on Agilent Technologies' acquisition of Population Genetics Technologies' sequencing IP related to NGS molecular and sample barcoding (see ***IBO*** 7/31/17). The IP is already used as part of Agilent's target enrichment product portfolio for NGS sample preparation. Asked about additional product introductions based on the IP, an Agilent spokesperson told ***IBO***, "Agilent will continue to launch new products in both the SureSelect and HaloPlex NGS target enrichment portfolios including the patented technology in 2018. Agilent is also investigating the incorporation of capabilities brought with this portfolio into additional technologies currently under development."

A number of NGS barcoding technologies are currently available. Discussing how the newly acquired IP compares to other barcoding technologies, Agilent commented, "Through product developments made possible by an earlier license agreement with Population Genetics, Agilent became one of the first companies to commercialize a high-sensitivity target enrichment solution incorporating molecular barcodes. This enabled Agilent users to accurately and reproducibly detect down to very low allele frequencies (below 0.1%)." She added, "We are confident that the greater scope of IP obtained through this acquisition will enable Agilent to enhance our offerings to meet increasing NGS market demands for greater sequencing efficiency and accuracy."

Government

The FDA has informed Congress that it found issues such as illegal ingredients and contamination in cosmetics imported from 181 countries last year. Most of the 29,000 foreign countries from which the cosmetics originated have not registered with the FDA, since it is not a requirement. By volume, cosmetics imports are a large part of imports that the FDA inspects; however, the Agency only has the equivalent of 6 full-time inspectors to monitor the 3 million shipments of cosmetics that come into the US each year. These cosmetics include lipsticks, eyeliners, face powders and tattoo inks. Although the FDA is requesting that Congress provide more resources and authority to monitor cosmetics shipments, the Agency stated that they are "confident" that the vast majority of cosmetics sold in the US, even if imported, are safe.

Last year, the FDA inspected 9,781, or 0.3%, of the three million cosmetics shipments, based on companies that have had issues with the Agency previously. Of those inspections, 15% resulted in "adverse findings." Lab tests were even fewer and farther between, with only 364 shipments being inspected in a lab last year. Of those, 20% led to adverse findings, including bacterial contamination, illegal color additives and unsafe chemicals, such as mercury. Based on adverse findings, approximately 2,000 shipments are refused entry into the US per year, with many of those products coming from France, Canada, China, India and South Korea.

Source: *The New York Times*

Chemicals

According to a survey conducted by *Chemical and Engineering News* (*C&EN*) on the global top 50 chemical companies, the chemical industry is continuing its strange pattern from the last couple years: declining sales, yet increasing profits. Combined, sales for the top 50 companies dropped 4.4% to $744.3 billion in 2016, including decreases for 38 of the companies. For the 47 public companies, however, combined profits grew 2.6% to $98.2 billion in 2016. Out of the 50 companies, 17 reported decreases in their earnings, while no company suffered losses. This pattern is similar to 2015, when sales decreased 10.8%, yet profits increased 15.1%. This unusual pattern is explained by falling oil prices and a robust economy.

The global top 50 list is similar in structure to last year, with changes including the removal of Honeywell, which fell from the ranking due to spinning off its chemical business, and of PotashCorp, which was also taken off the list due to declining sales. The leading global chemical companies in the world are BASF, with $60.6 billion in sales in 2016; Dow Chemical, with sales of $48.2 billion; and Sinopec, which had sales of $42.8 billion and was the only company to post an increase in sales out of the top 10 chemical companies.
Source: *C&EN*

Pharmaceuticals

To protect themselves from US regulations attempting to lower drug prices, generic drug makers are looking to M&A to increase scale and to sell off specialty units. Generic drugs are less expensive versions of name brand therapeutics, and are being pushed to the forefront with the US government's latest efforts to decrease the cost of pharmaceuticals. To achieve this, the FDA has accelerated the drug approval process, which would result in potentially 4,000 new drugs on the market within the next few years. For generic drugmakers Impax and Periggo, sales fell by 21% and 12% in the first quarter of the year, respectively, with analysts forecasting continued declines. Through M&A, pressure would be reduced by decreased costs and competition, as well as new products and markets. It would also help companies make better deals with drug distributors, which manage approximately 90% of drug revenues.

Aside from M&A as a strategy to cut costs and increase profits, companies are also exploring foreign investments

from India and China, where the generic drug market is booming. According to the *Journal of the American Medical Association*, the US spends more than twice as much on drugs per capita as any other industrialized nation.
Source: *Reuters*

Hungary

In 2016, over HUF 427 billion ($41.6 billion), or 1.22% of Hungary's GDP, was invested into R&D, an 8.8% decrease. R&D expenditures in the business and government sectors fell 7.9% each, while higher education R&D decreased 16.1%. By sources, R&D expenditures financed by the business sector improved 3.5%.

In regards to research units, defined as "research and development institutes and other budgetary units, higher education institutions and business enterprises," 2,727 units were operating in Hungary in 2016, a 2.6% drop. R&D personnel totaled 54,600, a 1.3% increase, but due to a decrease in technicians and support staff, the higher number of R&D personnel did not translate into greater R&D, as research activities generally declined 2.8%.

As of 2015, the largest number of research units were in Central Hungary, which houses 1,501 research institutions, with 1,283 in Budapest alone. The Great Plain and North followed with 777 operating research units and Transdanubia housed 523.

By region, the greatest R&D investments were made in Great Plain and North in 2015, with HUF 800.8 million ($3.0 million) invested in machines, equipment and vehicles, and a HUF 1.0 billion ($3.9 million) budget for buildings and other structures, totaling HUF 1.9 billion ($7.0 million) in R&D expenditures.

Source: *Hungarian Central Statistical Office*

South America

Numerous research institutions in Brazil and Argentina have been adversely affected by funding cuts. In Brazil, the federal government announced major cuts across all government agencies in March, decreasing the proposed 2017 science budget by 44% and making it the lowest federal science budget since 2005 at BRL 2.8 billion ($888 million). This has added extra pressure on scientists, as the government has been cutting the science budget every year since 2013.

Similarly in Argentina, the federal government reduced the budget of the science ministry by 36%. Junior researchers especially have been facing challenges, as the National Scientific Technical Research Council cut its proposed number of potential new research posts in half due to budget cuts.

Both Brazil and Argentina have made efforts to fund research through the private sector, but results so far have been mixed, with no major changes yet.

Source: *Nature*

China

Late last month, the Chinese government announced that over 400 researchers that contributed to approximately 100 scientific papers, now retracted, will receive disciplinary action due to peer-review fraud. Chinese officials stated they have a "zero tolerance" policy for research fraud and that the scientists' transgressions have damaged the country's scientific reputation. Penalties include canceled promotions, honors and grants, as well as many institutions barring the accused scientists from continuing their research at their facilities. Of the approximate 100 papers, 80 papers contained actual research outcomes, 9 were completely fraudulent and 12 had been bought from

third parties by the “authors,” according to the investigation conducted by the Ministry of Science and Technology (MOST). MOST also concluded that 95 papers provided by third-party companies had cited false experts and reviews, and that in at least 6 cases, at least 1 author committed the fraud themselves.

While China has had issues with research fraud in the past, these penalties are considered to be the harshest. Many agencies joined MOST to investigate the matter, including the Ministry of Education, and the China Association for Science and Technology.

Source: *Science*

Surface Science

Company Announcements

Etaluma and **DR Vision** announced in June a strategic partnership to combine their respective Lumascope inverted LS microscope, and Aivia image visualization and analysis software. The solution is designed for image-based assays, including live-cell assays.

JEOL announced in June that it initiated in April a collaboration with **Tohoku University** to develop a soft x-ray emission spectrometer and spectrum database.

In June, **Nikon** announced a reorganization of its business segments, beginning March 31, 2018. The Instruments Business, consisting of the Microscope Solutions and the Industrial Metrology Business Units, will be dissolved. The Microscope Solutions business, along with the Medical Business Development Division, will form the new Healthcare Business Unit.

In July, **Nikon Instruments** announced the development of the Nikon Imaging Center at the **University of California, San Diego**, which will provide imaging technology. It will be the third Nikon Imaging Center in North America.

Leica Microsystems named in July **Opti-Tech Scientific** as its exclusive representative for microscope solutions for industrial, materials research and forensic science in Québec, Canada. Opti-Tech currently represents Leica Microsystems’ imaging products in several regions of Canada.

In July, **ZEISS** announced its entry into the semiconductor process control market, forming the Process Control Solutions business unit, part of the ZEISS Semiconductor Manufacturing Technology business group. The unit’s product lines include the ZEISS Crossbeam and MultiSEM electron microscopes, and the ZEISS ORION NanoFab ion beam microscope. In connection, ZEISS opened a Customer Center in Pleasanton, California, in June.

In July, **ZEISS** announced the term of office extension of President and CEO Dr. Michael Kaschke until June 2020.

Product Introductions

LIG Nanowise launched in May the Nanopsis One based on its Super-resolution Microsphere-Assisted Lens (SMAL), which uses a microsphere to collect the invisible sub-wavelength light and convert it into a virtual super-resolution image. The resolving unit is sub-100 nm across X, Y and Z planes.

In July, **Shimadzu Japan** launched the SPM-8100FM SPM for ultra-high-resolution observation and high throughput. Compared to the SPM-8000 FM, it offers 5 times faster data acquisition and 4 times larger maximum scan range.

Hitachi High-Technologies released in July the TM4000 and TM4000Plus tabletop microscopes. New features include export of SEM images into a wider range of software formats, assisted navigation of a sample during visual field search and a motor-driven stage to select regions of interest via digital navigation.

Hitachi High-Technologies launched in July the new ETHOS FIB-SEM, featuring a new magnetic/electrostatic compound lens to deliver sub-nanometer imaging features in high contrast for low-voltage SEM applications. Sales will begin this fall.

In July, **Phenom-World** introduced the fifth generation desktop Phenom Pro and ProX SEMs, featuring enhanced imaging performance, a 20% resolution improvement, a larger choice of detectors and new software enabling more applications.

JEOL released in July the 4DCanvas STEM Detector for TEM, which records the position and intensity of all transmitted, diffracted and scattered electrons as a 2D pattern for every pixel of an SEM image. The detector acts as a highly sensitive multichannel STEM detector with 264 x 264 channels (one per pixel).

In August, **JEOL** launched the JSM-IT500HR SEM, featuring a high-brightness electron gun and the Multi Touch Operating System. It is available in two models: the JSM-IT500HR/LV for high- and low-volume image observation, and the JSM-IT500HR/LA with a EDS system.

In August, **WITec** announced the availability of its RISE (Raman Imaging and Scanning Electron) microscope with the ZEISS Sigma 300 FE-SEM for correlative Raman-SEM, enabling 3D chemical characterization. The fully integrated instrument is available as an OEM product through ZEISS that features a standard, unmodified vacuum chamber and SEM column, along with a complete confocal Raman microscope and spectrometer.

Thermo Fisher Scientific released in August the Thermo Scientific Krios G3i and the Thermo Scientific Glacios cyro-TEM for structural biology. The systems can be used together for a single particle analysis workflow or independently. The Krios G3i features enhanced automation. The Glacios cyro-TEM provides an entry path into cryo-EM with a small footprint and ease of use.

In August, **Thermo Fisher Scientific** unveiled the new Thermo Scientific Aquilos, calling it the first commercial cryo-DualBeam system dedicated to the preparation of frozen, thin lamella samples from biological specimens for high-resolution tomographic imaging in cryo-TEM.

In August, **Thermo Fisher Scientific** launched the new compact Thermo Scientific Talos F200i S/TEM for materials research in research labs. It allows for customization to meet specific lab's requirements and includes automated features.

Thermo Fisher Scientific introduced in August the new Thermo Scientific Quattro FE environmental SEM for materials science research under a wide range of experimental conditions, including hot, wet or chemically active. Accessors include a CL detector and high-vacuum heating stage.

In August, **Bruker** released the XMethod software package, calling it the world's first software package for the analysis of composition and thickness of single or multiple layers based on data obtained by sample excitation with the XTrace micro-focus x-ray source for SEM.

Oxford Instruments introduced in August a solution for real-time chemical imaging by EDS, combining the new fast SDD, the Ultim Max, and AztecLive software. It enables real-time sample navigation. The Ultim Max can collect maps of active areas up to 170 mm^2.

Sales and Orders of Note

In June, the **University of Limerick's Bernal Institute** announced the installation of a **Thermo Fisher Scientific** Titan Themis TEM, which it valued at €6 million ($7 million).

Liquid Chromatography

Company Announcements

AkzoNobel announced in July the appointment of Thierry Vanlancker as CEO. He replaces Ton Büchner, who stepped down for health reasons.

In July, **Chiral Technologies**, a **Daicel** company, named **Biotchnology Latina** as an exclusive distributor for Peru.

Tosoh Bioscience announced in August a partnership with **PolyAnalytik** for distribution of its EcoSEC GPC system and TSKgel HPLC columns in Canada, and the Eastern and Midwestern regions of the US.

In August, **3M** announced a six month research collaboration with the **University College of London** to quantify the value of purifying cell culture fluid with its Emphaze AES Hybrid Purifier before continuous chromatography.

Product Introductions

Kromasil, an **AkzoNobel Specialty Chemicals** brand, launched in June pre-packed EternityXT columns, available in 3 particle sizes, 1.8 µm, 2.5 µm and 5 µm, and three surface modifications, in C18, C8 and PhenylHexyl.

Kromasil released in July the Kromasil diC4 stationary phases with 300 Å pore size for biomolecular separations. It ships in bulk in 10 µm and 16 µm particle sizes.

Extending the InfinityLab series with a purification system, in June, **Agilent Technologies** introduced the Agilent InfinityLab LC purification solution, comprised of 11 modules. The Agilent 1260 Infinity II Prime LC System features a pressure range up to 800 bar, quaternary mixing, specially designed columns and a new local interface. The Agilent 1260 Infinity II SFC system features improved performance.

Thermo Fisher Scientific debuted in June a new range of Thermo Scientific MAbPac RP 1 mm columns for characterization of monoclonal antibodies, fragments, variants, antibody drug conjugates and proteins. They feature a 1 mm internal diameter.

Jasco introduced in June the redesigned Prep-4388 preparative SFC. New features include mass-directed preparation using a single quadrupole MS and a higher flow rate for 3 cm columns.

In June, **Sartorius** expanded its range of single-use membrane chromatography solutions with Sartobind Cassettes for capture and polishing during large-scale bioprocessing. Multiple cassettes can be set up, resulting in maximum membrane volumes of 20 L, 50 L or 100 L.

In June, **PharmaFluidics** introduced its micro-Chip-based µPAC ultra-high-resolution columns. The Pillar Array Columns are particularly suitable for applications in proteomics, lipidomics, metabolomics and bottom-up analysis of mAbs.

Fortis Technologies launched in June the SpeedCore C18-PFP core shell stationary phase, available in 2.6 µm and 5 µm particles.

In July, **Orochem Technologies** introduced Gazelle UHPLC columns. The available stationary phases are C18, biphenyl and PFP.

Sample Preparation

Product Introductions

ProZyme launched in June the Gly-X 2-AB Express and Gly-X Instant AB kits for streamlined N-glycan analysis. The 2-AB Express shortens sample preparation time to two-and-a-half hours, or, with Instant Dye, one-and-a-half hours.

In June, **Alpaqua Engineering** released the Magnum FLX24 Universal 24-well Magnet Plate for magnetic

bead–based nucleic acid isolation. It features solid core ring magnets for more rapid separation of all sample volumes and low-volume nucleic acid elution.

Miltenyi Biotech introduced in June the MACSprep PBMC Isolation Kit, human for the preparation of highly pure peripheral blood mononuclear cells from human whole blood in 25 minutes and without density gradient centrifugation.

In June, **Cayman Chemicals**, in collaboration with **PinPoint Testing** and **Biotage**, introduced the ToxBox THC/THC Metabolite Pack, a high-throughput solution for cannabis testing by LC-MS/MS. The Pack features a 48-well-plate system and 3-step workflow.

Cole-Parmer launched in June the Arcis-Sample Preparation System for DNA and RNA extraction in 3 minutes with as little as 3 µL of sample.

In June, **Chromatrap** announced that **BioLegend** has chosen its ChIP technology for BioLegend's chromatin immunoprecipitation kits, offering BioLegend's Go-ChIP-Grade antibodies and ChIP kits for epigenetics research.

Porvair released in July an easy-to-use 96-well SLE microplate for use with biological fluids.

In July, **Diagenode** and **PreOmics** unveiled a standardized solution for proteomics sample preparation. It combines their respective Bioruptor sonication system and in-StageTip (IST) Kit. The IST Kit is available for 8 or 96 reactions.

Bioprocess Analytics

Company Announcements

In May, **Sartorius Stedim Biotech** announced an agreement with **Nova Biomedical** to integrate Nova's BioProfile FLEX2 into its ambr mullti-parallel bioreactor systems for automated, in-line cell analysis (see below).

In June, Ireland's **National Institute for Bioprocessing Research and Training** (NIBRT) and **GE Healthcare** opened a training center, the NIBRT-GE Single-Use Centre of Excellence, for the training of up to 1,500 professionals annually.

In June, **Thermo Fisher Scientific** announced the opening of a customer evaluation center for single-use technologies at its production facility in Cramlington, UK.

In August, **MilliporeSigma** formed a strategic alliance with **Baylor College of Medicine, Houston**, Texas, and its vaccine product development partnership, **Texas Children's Hospital Center for Vaccine Development**, to advance vaccine R&D for neglected and emerging infections. The partners will work to optimize the vaccine manufacturing process to increase vaccine stability and yield, initially targeting the parasitic disease schistosomiasis.

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Product Introductions

Hamilton Bonaduz introduced in March single-use sensors for pH and DO for bioprocess applications. The electronic components can be used multiple times.

In May, **Eppendorf** launched the BioFlo 120 bioprocess control system for microbial and mammalian cell culture R&D applications. It features universal connections for digital **Mettler-Toledo** ISM and analog sensors, and the new Auto Cultures modes for push-button control.

BioOutsource, a **Sartorius Stedim Biotech** company, launched in May chemistry testing services for characterizing the physiochemical properties and structural attributes of therapeutic mAbs.

In June, **Startorius Stedim Biotech** introduced the ambr 15 automated micro bioreactor system combined with the

Nova Biomedical BioProfile FLEX2 automated cell culture analyzer for running, sampling and analyzing massive numbers of cell conditions during cell line and media development by Design of Experiments. The complete cycle time is 6–7 minutes.

Sartorius Stedim Biotech released in June the Active Dashboard 2 software solution, which provides real-time process information from multivariate SIMCA-online data analysis systems, part of Umetrics' Suite of Data Analytics Solutions. New features include innovative data visualization options and the ability to connect other data sources.

In July, **RoosterBio** unveiled the RoosterReplenish-MSC-XF bioreactor feed designed to economically and rapidly scale up 3D culture for bioprocess hMSC banks.

IKA launched in July the IKA Algaemaster 10 control, a closed photo bioreactor system, constructed from entirely inert materials.

ABEC released in July the single-use CSR (Custom Single Run) Bioreactor with a production volume of 4,000 L.

In July, **Pall**, a **Danaher** company, released the mPath bioreactor control system for single-use process development--scale bioprocesses. It supports the Allegro XRS 25 bioreactor. It features plug-and-play connectivity and provides access to features of Pall bioreactors that other commercial control options do not allow. Six mass flow controllers are standard.

INFORS announced in August that its eve bioprocess platform software is now compatible with a number of different bioreactors, including those from **Applikon**, **Matlab** and **Sartorius**. It supports all OPC standards, and offers a Rest API used to connect analytical devices and software.

Reported Financial Results

$ in Millions USD	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Agilent Technologies	Q3	30-Jun	$1,114.0	6.7%	$201.0	37.7%	$175.0	41.1%
Agilent Tech. (Life Sci. & App.)	Q3	30-Jun	$531.0	5.4%	$113.0	17.7%	NA	NA
Agilent Tech. (Diag. & Genom.)	Q3	30-Jun	$197.0	9.4%	$33.0	-2.9%	NA	NA
Agilent Tech. (Crosslab)	Q3	30-Jun	$386.0	7.2%	$90.0	9.8%	NA	NA
AMETEK	Q2	30-Jun	$1,064.0	8.8%	$232.4	6.1%	$150.5	8.9%
AMETEK (Electronic Instruments)	Q2	30-Jun	$657.7	10.3%	$165.2	8.6%	NA	NA
Becton, Dickinson	Q3	30-Jun	$3,035.0	-5.1%	($223.0)	NM	($165.0)	NM
Becton, Dickinson (Life Sciences)	Q3	30-Jun	$997.0	3.5%	$199.0	-0.5%	NA	NA
Bio-Rad Laboratories	Q2	30-Jun	$504.7	-2.3%	($2.4)	NM	$5.0	-72.0%
Bio-Rad Laboratories (Life Sciences)	Q2	30-Jun	$179.4	-0.3%	($23.0)	NM	NA	NA
Bio-Techne	Q4	30-Jun	$156.6	16.2%	$41.5	3.7%	$28.8	12.4%
Bio-Techne (BioTechnology)	Q4	30-Jun	$97.2	15.2%	$47.9	5.7%	NA	NA
Bio-Techne (Protein Platforms)	Q4	30-Jun	$26.8	22.0%	$4.3	103.1%	NA	NA
Bruker	Q2	30-Jun	$414.9	11.6%	$33.5	64.2%	$23.4	61.4%
Bruker (Scientific Instruments)	Q2	30-Jun	$362.5	4.8%	$30.5	61.4%	NA	NA
Fluidigm	Q2	30-Jun	$23.9	-15.1%	($16.5)	9.1%	($16.9)	9.0%
Illumina	Q2	30-Jun	$662.0	10.3%	$143.0	-11.7%	$128.0	6.7%
Luminex	Q2	30-Jun	$76.5	19.2%	$7,482.0	-0.2%	$5,544.0	-1.9%
MTS Systems (Testing)	Q3	30-Jun	$124.4	-6.9%	$8.7	-18.5%	NA	NA
NanoString Technologies	Q2	30-Jun	$34.6	52.9%	($3.3)	65.3%	($4.6)	57.8%
Pacific Biosciences	Q2	30-Jun	$20.1	-3.2%	($24.4)	-35.0%	($25.5)	-38.1%
PerkinElmer	Q2	30-Jun	$547.0	2.0%	$76.0	14.7%	$204.1	219.6%
PerkinElmer (Discovery & Analytical Solutions)	Q2	30-Jun	$383.1	0.4%	$64.0	6.6%	NA	NA
PerkinElmer (Diagnostics)	Q2	30-Jun	$163.8	5.9%	$48.8	3.1%	NA	NA
Teledyne (Instrumentation)	Q2	30-Jun	$233.8	6.2%	$30.8	53.2%	NA	NA
Xylem (Water Infrastructure)	Q2	30-Jun	$482.0	-0.4%	$74.0	12.1%	NA	NA
Other Currencies (in Millions)								
Eppendorf	H1	30-Jun	€327.9	7.3%	€63.2	9.0%	NA	NA
GL Sciences	Q1	30-Jun	¥5,105.0	20.7%	¥413.0	79.6%	¥269.0	149.1%
HORIBA	Q2	30-Jun	¥41,660.0	7.6%	¥3,516.0	34.9%	¥2,681.0	183.1%
HORIBA (Process & Environmental)	Q2	30-Jun	¥3,885.0	6.7%	¥148.0	-26.4%	NA	NA
HORIBA (Scientific)	Q2	30-Jun	¥5,668.0	-3.0%	-¥379.0	NM	NA	NA
JEOL	Q1	30-Jun	¥15,801.0	-17.2%	-¥2,169.0	-55.6%	-¥2,125.0	4.5%
JEOL (Scientific & Measurement Instruments)	Q1	30-Jun	¥9,909.0	-14.7%	-¥1,698.0	-23.7%	NA	NA
Merck KGaA (Life Science)	Q2	30-Jun	€1,495.0	4.5%	€221.0	33.1%	NA	NA
Shimadzu	Q1	30-Jun	¥75,803.0	8.7%	¥3,884.0	-13.8%	¥2,428.0	-21.3%
Shimadzu (Analytical & Measuring Instruments)	Q1	30-Jun	¥46,122.0	8.6%	¥4,735.0	-4.0%	NA	NA

NA = Not Available, NM = Not Meaningful