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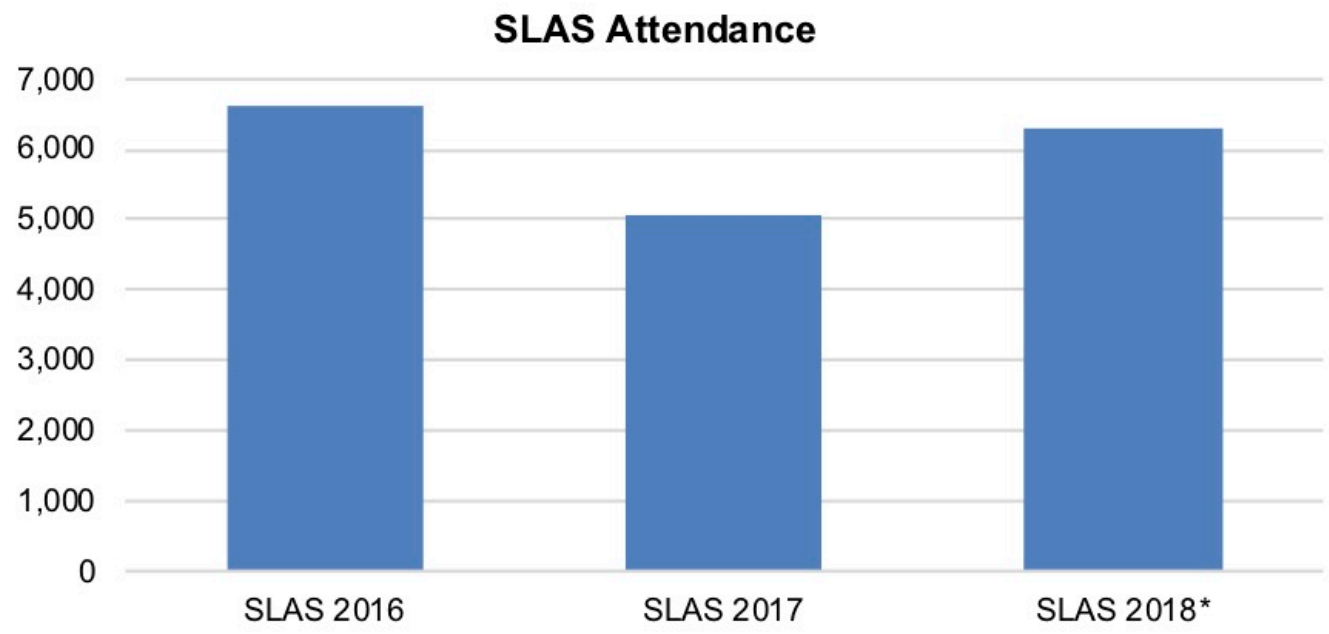
SLAS 2018: Companies Unveil New Platforms

Held in San Diego, California, the seventh annual SLAS (Society for Laboratory Automation and Screening) conference took place from February 3 to February 7. Conference attendance rose 24.3% from last year (see ***IBO*** 2/15/17), when the conference took place in Washington, DC, to 6,628 participants, according to preliminary figures.



** Estimated*

As usual, the conference and exhibition focused not only on laboratory automation, but also associated techniques addressing the challenge of making biological analyses more efficient, more informative and faster. As in years past, areas of particular emphasis not traditionally associated with lab automation included informatics, MS, cellular biology, microfluidics and NGS. The show is focused on pharmaceutical applications, stemming from a history rooted in HTS, and the continuing challenges in reducing the costs and improving the efficiency of drug discovery.

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In June, SLAS will hold its first European conference in Brussels, Belgium, from June 27 to June 29. Next year's US

conference will take place in February 2–6 in Washington, DC. SLAS 2020 and SLAS 2021 will again return to San Diego, while SLAS 2022 will move to Boston, Massachusetts.

Presentations

The Data Analysis and Informatics track featured a presentation by Scott Harrison, PhD, Principal Scientist at Merck entitled, "Preparing Early Drug Discovery for the Machine Learning Revolution." Dr. Harrison discussed his experience at Merck utilizing Quantitative Structure Activity Relationships (QSAR) methods. Defining QSAR, he called it, "a form of machine learning that attempts to predict an activity of a compound using features present within the chemical structure." Applications include polypharmacology modeling and high-throughput screening prioritization.

He emphasized the importance to the success of QSAR of what he termed the "human side of predictive sciences." Key steps in this direction included convincing scientists of the meaningfulness of the data, embedding the platform in a workflow that chemists were already using and adjusting scientists' expectations that QSAR would eliminate typical experimental error. He also emphasized the value of so-called "bad models" that show what will not work.

As part of the "High Definition Technology Platforms for Single Cell Analysis" track, Caltech Research Professor Long Cai presented his lab's work using a seqFISH (Sequential Fluorescence *in situ* Hybridization) for *in situ* 3D multiplexed imaging of hundreds of RNA molecules within a single cell for transcriptional profiling. As Dr. Cai noted, single molecule FISH is currently the "gold standard" for quantifying mRNA. His lab employs the multiplex capacity of seqFISH by using temporal barcodes, rather than spatial or spectral barcodes. One of the advantages of temporal barcoding is it can hybridize against the same RNA multiple times, with an exponential increase in multiplexing. He also noted that single cell RNAseq data can be mapped to seqFISH data.

New Automation Approaches

On display in the exhibition hall was the evolution of lab automation even for the most established of technologies. Two companies at the show challenging traditional lab automation design were HighRes Biosolutions and Formulatrix. **Formulatrix** previewed its ROVER Laboratory Automation Platform, which utilizes autonomous, compact moving or "roving" boxes to move microplates between stackers and dispensers using machine vision. This provides flexibility and scalability with up to five "rovers" that can be used simultaneously. Pipetting stations employ sensors to automatically adjust for liquid level, liquid class and labware geometry. The company told ***IBO*** that the system eliminates the need for a traditional automation engineer. The system is expected to launch next year.

HighRes Biosolutions' Prime integrates liquid handling, labware transport and labware storage into a vertical, mobile platform. It reconfigures the traditional layout of workbench from a horizontal to a vertical orientation to address the problem of unused deck space and shrink the overall footprint. A dynamic tray system and under-deck plate storage enables continuous pipetting and reloading. Safety sensors eliminate the need for physical guarding and improves flexibility. The movable system with on-system gas, ethernet and electrical connections allows for easy docking to other modules for quick reconfiguration for other applications. Pricing starts in the low $300,000s. The company told ***IBO*** that it aims to broaden the range of what can be automated.

A partnership was also behind the introduction of the new Access Dual-Robot System. The high-throughput, modular platform, developed by **LabCyte, Brooks Automation** and **Titian Software**, creates an integrated automation system for use with LabCyte's acoustic liquid handling technology. It features two robots for parallel processing, ability to add shelves and docks to expand, as well as redundant devices to ensure continuous operation, and an environmental distribution system. The Access incorporates sample handling, storage and management, as well as liquid dispensing and transfer. The system's capabilities are made possible by LabCyte's new Echo 655T Liquid Handler. The company's first system to work with both plates and tubes, the system can dispense DMSO and aqueous fluids. Designed especially for the Echo 655T, Brooks Life Sciences' new FluidX AcoustiX Sample Tubes, are designed for long-term storage and a barcode compatible with acoustic liquid handling. The three new products are expected to ship within the next couple of months.

Asked about the creation the sample management systems, Chris Grimley, vice president of Marketing for LabCyte, told ***IBO***, "Developing a system with the level of sophistication and complexity of the new acoustic sample management solution would be extremely challenging for any single company. By choosing to collaborate with Labcyte, Brooks Life Sciences and Titian Software, AstraZeneca has ensured that they will receive a fully integrated

and tested system that represents the state of the art in all the key technology areas related to sample management, namely liquid handling, automation, compound storage and software integration."

Clinical

SLAS 2018 also marked the debut of **Tecan**'s Fluent Gx workstation, the latest model of the company's Fluent workstation platform. The Fluent Gx is designed for clinical and regulated environments, including NGS sample preparation and nucleic acid purification. Based on the Fluent 2018 model, launched late last year, the Fluent Gx adds the Fluent Gx Assurance Software for ease of use and regulatory compliance. The Fluent Gx is expected to be registered with the US FDA as a Class I Medical Device in coming months. The platform is currently available in Europe. At a press conference announcing the introduction, Tecan CEO David Martyr highlighted the company's presence in the clinical diagnostics market, noting that the market accounts for over 60% of revenues. Around one hundred employees work in quality and regulatory positions at Tecan.

Complete Solutions

PerkinElmer and Thermo Fisher Scientific are two companies that provide users with a package of lab automation products: instruments, kits, consumables and software. **PerkinElmer** exhibited a number of new products and assays at SLAS 2018. Speaking with ***IBO***, Alan Fletcher, PhD, vice president and general manager of the Discovery Solutions business at PerkinElmer, discussed the interactions between the company's Diagnostics division and its Discovery Solutions business, which also includes offerings for LDTs. Mark Dupal, Global Portfolio Director, Microfluidics and Automation, Applied Genomics, for PerkinElmer explained, "The JANUS system has two types: a Research Use Only (RUO) and an IVD version. We manufacture all the JANUS instruments under the same IVD process though." Mr. Dupal also mentioned the company's work to utilize its automation capabilities for its food testing business.

Dr. Fletcher also noted the company's broad set of automation solutions, both instruments and kits. The extensive set of kits targets all biomarkers of choice: genes, proteins or cells. The company launches with 10–12 kits each month. Dr. Fletcher told ***IBO*** that "we have reinvigorated our entire portfolio of assays, but with a focus on cell-based assays."

At the show, the company highlighted the high-throughput NEXTprep-Mag Automated cfDNA isolation kit for extraction of cell-free DNA (cfDNA) from plasma or serum, which was released this quarter. Applications include NIPT and oncology. Dr. Fletcher told ***IBO*** that the question currently being addressed around cfDNA is not if it is useful, but how useful it can be, for example, in applications such as monitoring tumors. The booth also featured an expanded line of LANCE Ultra TR-FRET assays.

Among the instruments on display in the booth was the compact VICTOR Nivo Multimode Plate Reader, released last fall, which replaces the VICTOR X platform. It measures 8 x 11 in (20 x 27 cm). For use with both biochemical and cell-based assays, the Reader is designed for academic labs and more routine applications such as assay development. Its compact size is made possible by a mechanical filter wheel for both excitation and emission.

Thermo Fisher Scientific announced three new products at the show. The Thermo Scientific inSPIRE is a vertical robotic platform designed for users looking for an automation system with capabilities between benchtop and industrial-scale systems. It enables integration of multiple instruments through shelving modules. Up to four shelves can be added with additional access via docking tables. Addressing user experience, the system is remarkably quiet with lighted handles to provide visual signal as to system operation. Shipments will begin in the third quarter with orders taken starting in the second quarter. The system incorporates the new Thermo Scientific Spinnaker XT robot with vision capability for self-correction.

The company also launched the Thermo Scientific Cytomat SkyLine microplate storage and delivery system, claiming the highest capacity at 728 microplates. The plate separation technology allows plates and plate lids to be handled separately.

Launching its first in a series of application-based turnkey workflow solutions, Thermo Fisher introduced a cfDNA extraction solution incorporating several of its tools, the MagMAX Cell-Free DNA Isolation kit, protocols, as well as **Analytik Jena**'s CyBio FeliX liquid handler. Other turnkey systems to be launched are those for ELISAs, NGS library preparation.

Cell Analysis

At SLAS 2018, **Corning** launched the $3,000 Corning Cell Counter, exclusively available from Corning through a collaboration with **CytoSMART Technologies**. The compact Counter, weighing only 2 lb (1 kg), enables cell counting uses standard reusable hemocytometers or disposable slides. As Keith R. Olson, PhD, director, CLS Business Operations for Corning, told ***IBO***, the addition is part of Corning's efforts to offer researchers a complete workflow for cell culture. Through acquisitions and product development, as well as long-established product lines and brands, the company has steadily expanded such offering to encompass media, sera, vessels, surface and liquid handling equipment.

Corning also highlighted at the conference a new product line, Corning Dissolvable Microcarriers. As Dr. Olson explained, although microcarriers are not a new technology for cell culturing in bioreactors, the dissolvable microarrays utilize a plant-based polymer and enzyme, which are more gentle to cells during separation from the carrier. Corning plans to introduce its 1,536 Spheroid microplates in June and spheroid technology for flasks as early as next year.

Miltenyi Biotec displayed its MACSQuant X flow cytometer. Released in late 2017, the system is configured for high-throughput cell analysis and volumetric counting at high speed, with 3D plate compatibility. The model does not feature cell separation capabilities. The fully automated system tracks reagents via barcode, and is priced at about $200,000.

Miltenyi Biotec also displayed the multiMACS X automated cell separator, which has been on the market for about six months. The system adds automation (via a partnership with **Tecan**) to automate cell separation with Miltenyi Biotec's magnetic bead technology and products, thus enabling high-throughput processing with true walk-away capabilities. The system can be configured to provide both positive and negative selection, and is priced starting at about $160,000.

Molecular Devices introduced a new model in its ImageXpress line of high-content imaging systems, the ImageXpress Pico. While some of the products of the line use confocal imaging systems, the Pico uses a widefield CCD detector to produce automated cellular images. While this choice limits performance–particularly the absence of 3D imaging that confocal optics can provide–the company is confident that the instrument will appeal to researchers as a "personal" imager, with its small footprint and modest pricing. The new model is expected to begin shipping in a few months at a price in the $50,000s.

Sphere Fluidics premiered its Cyto-Mine Single Cell Analysis System. The system is capable of high-throughput analysis, sorting, imaging and dispensing of single cells. Using picodroplet technology, cells are encapsulated in growth media, while multiple imaging sensors select for picodroplets containing only single cells. Sorting via fluorescent-tagged antibodies allows screening for rare cells. The cartridge-based platform will facilitate expanded functionality in the future, as cartridges for label-free and gene editing selection are under development. The cost of the system is about $500,000.

StemoniX introduced its Assay Ready line of pre-plated cells. Available in 96- or 384-well formats, the plates are ready to use for high-throughput screening and drug discovery. Cell types currently available are iPSC-derived human cortical spheroids, cortical neurons and astrocytes, multipotent neuroprogenitor cells and cardiomyocytes. Cells are plated at high density; spheroids are plated at a minimum of four thousand spheroids per well. StemoniX has also formed agreements with leading research institutes to release pre-plated specialty cell lines in the near future.

Protein Based

Part and parcel of the lab automation market are partnerships, particularly as companies seek to compete with one-stop shops by providing integrated solutions. **Abcam** and **Molecular Devices** announced a collaboration at the show. Abcam will provide its CatchPoint SimpleStep ELISA kits optimized for use with Molecular Devices' multimode plate readers. This is one in a series of kits the companies plan to launch and expands Abcam's ELISA kits from colorimetric to fluorescent detection. The kits are currently available through Abcam.

Matthew Grow, PhD, senior director, Kits and Assays, at Abcam told ***IBO***, "This is the first product of our strategic collaboration with Molecular Devices. Although CatchPoint SimpleStep ELISAs have been optimized with Molecular

Devices' plate readers, they also can work with a number of other standard fluorescence plate-readers that cover the required fluorescence excitation and detection ranges. No other systems have been tested, and so with any untested system, assay optimization prior to using the assays to collect data is essential."

Abcam also showcased the FirePlex-HT multilplex immunoassay for high-content imaging. The 384-well assay measures up to 10 parameters with a two-step workflow and no-wash assay. The assay has been validated for use with the following instruments: **Molecular Devices**' ImageXpress Micro, **TTP Labtech**'s Mirrorball, **PerkinElmer**'s Opera Phenix and **Yokogawa**'s Cell Voyager 7000. Also available is a High-Content Imager Setup Kit to help researchers set up their laboratory for successful assay readout. Dr. Grow told ***IBO***, "We are actively working with researchers to validate other imaging systems using this kit."

German firm **NanoTemper Technologies** displayed its recently introduced Tycho NT.6 platform for quickly measuring protein quality, including structural integrity, using the protein's intrinsic fluorescence. The six-sample platform utilizes the company's MicroScale Thermophresis technology and capillary format to conduct protein measurements in solution. Run time is three minutes with a sample volume of 10 mL without dilution. Applications include assay development, testing antibody quality, and checking DNA-protein binding after CRISPR. The product is a first step prior to downstream characterization. The system is currently shipping. The company also introduced a robotic autosampler for the Prometheus NT.Plex system, which is used for examining protein stability.

Expanded Product Lines

Among the software companies exhibiting at SLAS 2018 was **Dotmetics**. An ELN and lab management software firm, Dotmetics has expanded from chemistry into biological solutions, which includes the Bioregister registration system for sequence-based, chemically modified and structure-less biological entities. Discussing the adoption of cloud-based computing, the company told IBO that many of its customers use both private and public clouds, and many have transitioned to the cloud following on premise installations. The company's biologics offerings also include the Vortex visualization solution for the analysis and presentation of data for collaborative research.

Hudson Robotics introduced an updated version of its Rapid-pH system for measuring pH in 96 well-plates. The new system includes an improved electrochemical head from **Mettler-Toledo**. In the future, potential new probes could be used to provide conductivity or other measurements. The benchtop system is small enough that it can fit inside a fume hood. The system is now available at a price of about $35,000.

Lab automation product provider and integrator **Peak Analysis & Automation** (PAA) announced the US launch of its low-cost compact S Lab automated plate handler with a capacity of up to 100 microplates. The system works with both unlidded and lidded plates. It features a fixed radius. The company also displayed the GX benchtop robot which features a 360° rotation on all axes as well as the ability to handle microplates in vertical or portrait orientation.

The Growing World of Companion Diagnostics

With the boundaries between research and diagnostics continuing to blur, companies are working on building strategies in which collaboration and innovation are more important than ever. One new set of collaborative partners is pharmaceutical companies. The companion diagnostic (CDx) market is an area where companies' instruments and clinical businesses are conflating, likely because the sector involves an integrated approach for clinical testing. With the participation of primarily instrument companies like Thermo Fisher Scientific, diagnostic and instrument companies such as QIAGEN, and clinical companies like HTG Molecular Diagnostics, the CDx sector is proving itself to be an attractive market.

CDx are tests, usually in vitro devices (IVDs), designed to assess whether a patient would be likely to respond positively to a corresponding, or companion, targeted therapeutic drug treatment. As of February 2018, the FDA has cleared or approved 41 CDx devices (IVD and imaging tools). Due to the prevalence and accessibility of technologies such as DNA sequencing continuing to rise, the development and regulatory clearing of CDx is expected to grow even more rapidly in the coming years.

The Steady Rise of CDx

This rising approvals of CDx is not lost on companies that traditionally were not in the market. For example, in November 2015, Thermo Fisher entered a long-term agreement with Novartis and Pfizer for the development and commercialization of a multi-marker, NGS-based CDx test for non-small cell lung cancer, while in October 2017, the

company announced an oncology CDx agreement with Blueprint Medicines to expand its NGS-based Oncomine Dx Target Test, which had been approved by the FDA earlier that year.

In fall 2016, HTG partnered with Merck KGaA in a broad CDx master agreement, utilizing the company's EdgeSeq gene expression technology, and the companies entered a complementary master collaboration agreement in December 2017 under which HTG will develop and manufacture a custom profiling assay for biomarker research. Likewise, other major players in the life sciences such as Agilent Technologies and NanoString Technologies have also partnered with pharmaceutical companies in CDx agreements, such as BMS and Eli Lilly, and Medivation and Astellas, respectively.

Thermo Fisher, QIAGEN and HTG all describe CDx as a priority. According to T.J. Johnson, CEO at HTG, the CDx market is a chief focus for developing a "medical menu" for the company's EdgeSeq platform. "We believe the new companion tests being developed for drug therapies will be a large catalyst for future instrument placements and increasing annuities (reagent sales)," he explained. "HTG is not a content-discovery company, so our partnerships with biopharma and collaborations with translational researchers provide our primary pipeline of new tests."

Although HTG has yet to receive FDA approval for a CDx, according to an SEC filing, as of December 31, 2016, the company had 36 active CDx development programs with 16 biopharmaceutical companies. Moreover, HTG received CE marking of its ALK*Plus* Assay in Europe last March, and expects to obtain FDA approval for the assay by late 2017/early 2018. If approved, the ALK*Plus* Assay will be used as a CDx for crizotinib therapy for ALK positive NSCLC cases.

QIAGEN and Thermo Fisher have received FDA approval for certain CDx (see table below). In a third quarter 2017 conference call, QIAGEN reported it had over 25 master collaboration agreements with biopharmaceutical companies for developing CDx for targeted cancer therapies.

Thermo Fisher has branched into the CDx market to help increase the availability and access of its NGS offerings. "CDx is a critical part of our strategy to continue enabling broader access to our Ion Torrent NGS platform," said Asia Chang, senior director of Product Management, Clinical Next-Generation Sequencing & Oncology, Thermo Fisher Scientific. "CDx represents an important segment of IVD solutions that deliver clinical utility and positive clinical outcomes. Our Clinical Next-Generation Sequencing and Oncology business is aimed at democratizing NGS technology, and diagnostics are a main thrust of this effort."

QIAGEN has a proven track record with CDx dating back almost a decade, compared to other companies that have entered the market relatively recently. "QIAGEN has been in the CDx business since our acquisition of DxS in 2009 [see ***IBO 9/30/09***] and we are the global leader in molecular-based companion diagnostic testing," said Jonathan Arnold, vice president and head of Partner for Precision Diagnostics at QIAGEN. The company's Precision Diagnostics segment aligns with QIAGEN's overall business strategy because, as Mr. Arnold explained, it allows for the development of diagnostic innovation and affords QIAGEN the opportunity to launch the new diagnostic content into its global installed platform base. "There are [four] key differentiators to our CDx market approach," said Mr. Arnold. "[We are a] trusted partner with pharma across the continuum from drug discovery to commercialization; [we have the] best-in-class menu breadth and depth of technologies and sample types, which allows QIAGEN to act as a true consultant to pharmaceutical companies to ensure the diagnostic meets their needs independent of technology; [we have] strong regulatory/quality experience; and [we have] global commercial channels."

QIAGEN & Thermo Fisher Scientific US FDA-Approved/Cleared CDx Devices	
Device Trade Name	**Device Manufacturer**
therascreen EGFR RGQ PCR Kit (Gilotrif)	QIAGEN Manchester
therascreen® EGFR RGQ PCR Kit (Iressa)	QIAGEN Manchester
therascreen KRAS RGQ PCR Kit	QIAGEN Manchester
Oncomine Dx Target Test	Life Technologies (Thermo Fisher)
SPOT-LIGHT HER2 CISH Kit	Life Technologies (Thermo Fisher)

source: FDA

Adapting with the Market Landscape

The instruments used in CDx are largely made for clinical testing. HTG, Thermo Fisher and QIAGEN's instruments are made specifically with clinical applications in mind. According to Mr. Arnold, QIAGEN instruments such as the RotorGene-Q, the QIAsymphony and the GeneReader NGS-System were specifically developed to meet commercial testing requirements of clinical research labs, including turnaround time, scalable throughput of samples, cost per sample and ease of use. "As an example, a key requirement for developing CDx tests is having an IVD-compliant instrument," he explained. "This means the platform must be built under design control ensuring the platform will meet the rigorous review process of regulatory agencies, and that is true for all our systems." The GeneReader-NGS System is also unique from competitive NGS offerings, he noted, as it was always designed as a solution for clinical research applications.

Similarly, HTG, which describes itself as a clinical company, told ***IBO*** that the EdgeSeq did not need to undergo any changes since it was designed specifically for clinical labs; however, any potential future modifications that are made will likely be related to software offerings. "We do provide RUO panels into key markets in order to build our business and develop possible diagnostic menu in a cost effective manner," said Mr. Johnson. "Each of our companion tests in development as well as other diagnostic menu will not likely require adaptation of the instrument, but possibly will have different protocols and probe designs that are software driven."

> ***"In the emerging precision medicine market, the line between research and diagnostics is blurring."***

Thermo Fisher's solutions for CDx have a presence in the oncology research market and were developed to undergo the regulatory process. "The foundational technologies integrated in the Oncomine Dx Target Test leverage the Ion AmpliSeq chemistry, the Ion Torrent PGM Dx system and the Ion Reporter software," he explained. "The primary effort was not technology-oriented to attain multiple CDx biomarkers—the effort was in partnership with pharma and the FDA to conduct the rigorous testing and studies to take our integrated solution through the FDA process."

Partnering with pharmaceutical companies also comes with a set of requirements that the companies need to meet. "[Pharmaceutical companies] must trust that the instrument/platforms are going to meet a high standard even before they invest in the development of the CDx assays on the instruments," Mr. Arnold said. "Based on joint go-to-market activities with our pharmaceutical partners for CDx and drug development, each CDx launch also accelerates the adaption of QIAGEN´s platforms."

Although Thermo Fisher has traditionally not been known as a diagnostics company, it has been slowly building upon its diagnostic segments in order to provide comprehensive workflows. “Thermo Fisher has traditionally been considered an instrument company; however, within the Thermo Fisher family of businesses, our diagnostic portfolio is not insignificant across our Phadia allergy portfolio and now with our Oncomine brand of solutions in oncology,” said Mr. Chang. “Our businesses have the advantage of supporting the entire pharma drug development process, from basic research through to commercial diagnostics.”

Companies like Thermo Fisher entering the CDx market is understandable, since the distinctions between discovery and clinical are starting to overlap. “In the emerging precision medicine market, the line between research and diagnostics is blurring,” said Mr. Johnson. “Biopharma needs a solution from biomarker discovery to commercialization of a companion diagnostic, and companies that can span that entire solution are advantaged.”

That advantage makes for the development of comprehensive workflows. HTG partnered with QIAGEN in 2016 for a five-year agreement for a complete NGS-based solution for the development, manufacturing and commercialization of oncology-based CDx tests (see ***IBO 11/30/16***). In January, the companies began a third project for a new NGS-based clinical trial assay with an undisclosed pharmaceutical company. The companies’ respective strengths combine to give an advantage that strictly diagnostic companies would not have. “With our QIAGEN partnership, we believe we have a full solution and customers are validating that with our publicly released new agreements,” said Mr. Johnson.

Integration as a Strategy

Collaborations are a key aspect of the CDx market, and companies that develop their own instruments bring an added value to their partners as well. For example, QIAGEN focuses on developing integrated workflows that meet regulatory requirements, and this strategy gives the company an extra benefit that their pharmaceutical partners also gain from. “This is a key advantage over other diagnostic providers who sell standalone instruments or develop tests on competitor´s instruments, which requires a lot of inter-company alignment,” said Mr. Arnold. “QIAGEN has the additional advantage of being a diversified life science and MDx company, which gives us a competitive advantage, because we can leverage innovative life science products for diagnostics markets and integrate them into diagnostic products to truly deliver complete solutions to labs, not individual tests or just instruments.”

> ***“Having a portfolio of solutions to address the care journey and enable labs to deliver meaningful answers is a critical part of our strategy.”***

This notion of a cohesive workflow is driving the growth behind companies entering the CDx market, and the three companies are focused on creating inclusive, complete and diverse workflows in order to extend their reach in the diagnostic sector.

Creating an integrated and complete clinical portfolio is a major aspect of the companies’ approach to the diagnostic market. As Mr. Chang explained, CDx is a specific designation by the FDA indicating that the IVD confirms that the corresponding therapeutic product is safe and effective. “Many other types of diagnostic applications such as screening, prognostic, etc. are part of the fabric of the diagnostic landscape,” said Mr. Chang. “Having a portfolio of solutions to address the care journey and enable labs to deliver meaningful answers is a critical part of our strategy.”

Diversifying CDx portfolios is key for QIAGEN. “In several cases, a CDx test is needed for the identification of patients being eligible for a specific treatment,” said Mr. Arnold. “Later the CDx can also be applied for diagnosis of patients, as in the case of CML [chronic myeloid leukemia], and possibly monitoring of treatment success, e.g., BCR-ABL testing for Gleveec in CML. There is another aspect, which could be considered subsegments of the same market, such as immunology testing where QIAGEN needs to be able to develop both RNA- and DNA-based solution for our pharma customers.”

HTG shares this sentiment of developing a robust pipeline that keeps up with new prospects in the CDx market. “A diversified portfolio is very important, but the majority of CDx assays will be signatures that predict response to the therapy,” said Mr. Johnson. “Certainly early detection and disease monitoring assays will all play critical roles in patient care, and we continually assess our pipeline versus emerging opportunities.”

ITC Rules Against Pacific Biosciences

Oxford, UK 2/8/18; Menlo Park, CA 2/8/18; Washington, DC —The US International Trade Commission (ITC) has ended its investigation of the alleged infringement of Pacific Biosciences' US Patent Nos. 9,404,146 and 9,542,527 by UK-based Oxford Nanopore's MinION and PromethION DNA sequencers. Pacific Biosciences filed the complaint in November 2016 (see ***IBO*** 11/15/16), and has patent infringement actions pending against Oxford Nanopore in the US, England and Wales, and Germany. "We disagree with the present determination of non-infringement in this lawsuit, and note that the ITC's construction of the term 'single-molecule sequencing' is inconsistent with both the commonly understood meaning of that term as well as relevant US Supreme Court and Federal Circuit precedent," commented Pacific Biosciences CEO Dr. Michael W. Hunkapiller. "We initiated the ITC action against Oxford Nanopore to stop use of its '2D' method in the United States that we believe infringes our patents," continued Dr. Hunkapiller. "We were pleased that, within months of filing the suit, Oxford Nanopore discontinued sale of its 2D products worldwide." Oxford CEO Gordon Sanghera stated, "We are pleased that Pacific Biosciences has failed, in this action, to prevent Americans choosing and benefiting from Nanopore single-molecule, real-time DNA sequencing." According to the ITC, this ruling affirms a July 2017 determination.

The respective patents at dispute in this case are entitled "Compositions and Methods for Nucleic Acid Sequencing" and "Compositions and Methods for Nucleic Acid Sequencing." The US court cases pending against Oxford Nanopore address three other patents (see ***IBO*** *5/15/17,* ***IBO*** *11/15/17). According to Oxford Nanopore's website, "The Ligation Sequencing Kit 2D offers a library preparation method for sequencing genomic DNA, amplicons and cDNA that prepares the sample for '2D' sequencing (sequencing the template and complement strands one strand at a time)."*

Anton Paar Enters New Markets

Graz, Austria 2/9/18—Anton Paar, a supplier of measuring instruments for density, concentration or dissolved carbon dioxide, has acquired Quantachrome Instruments for an undisclosed amount. Quantachrome Instruments provides characterization instruments for analyzing porous materials and powders using gas adsorption to measure the surface area of porous components. Based in Florida, the company has 170 employees. "Until now, we have mainly offered analytical solutions for the physical examination of liquids and particles. With this acquisition, our expertise in the analysis of solids will be expanded," stated Anton Paar CEO Friedrich Santner. "The combination of existing and new technologies from both companies will result in the creation of improved or new measuring solutions. Additionally, our strategic goal to have a US-based unit for research, development and production within the Anton Paar Group has been fulfilled." Quantachrome Instruments retains its operations in Florida and is now headed by Georg Cortolezis-Supp, executive director, Production & Purchasing at Anton Paar.

Quantachrome's product lines consist of gas, vapor and water sorption analyzers, gas displacement pycnometers, flow chemisorption analyzers, physisorption analyzers, expulsion porometers, intrusion porosimeters, mercury porosimeters, capillary flow porometers and tap density analyzers—all new product categories for Anton Paar. For particle analysis, Anton Paar currently offers the particle characterization product lines that were acquired from Cilas last year (see **IBO *6/15/17***). *This is Anton Paar's fourth acquisition in two years.*

Asked if Quantachrome serves a similar customer base as Anton Paar's other product lines, a spokesperson for Anton Paar told **IBO**, *"Yes, especially in particle characterization. Additionally, we see an added value for existing customers/multinational companies that are our customers and don't use these analytic technologies yet." Regarding growing the business, he commented, "Through the integration of Quantachrome into the sales and service network of Anton Paar, we offer a much broader customer base that will open up new business opportunities."*

AMETEK Acquires Another Instrument Firm

Berwyn, PA 2/1/18—AMETEK, a manufacturer of electronic instruments and electromechanical devices, has acquired moisture and gas measurement instrument company Arizona Instrument for $38 million. Arizona Instrument's annual revenues total $15 million**.** "Arizona Instrument is an exciting addition to AMETEK's growing presence in the food, pharmaceutical and environmental markets and nicely complements our Brookfield Engineering business," said AMETEK Chairman and CEO David A. Zapico. The company becomes part of AMETEK's Electronic Instruments Group.

Arizona Instruments provides the Computrac line of moisture balances, and the Jerome products, which are spectroscopy-based handheld and online instrument for mercury and hydrogen sulfide analysis. According to AMETEK's quarterly conference call, aftermarket sales account for about 40% of Arizona Instrument's total sales.

Antibody Company Merges with Distributor

Oxford, UK 2/12/18—Absolute Antibody and Kerafast have announced a merger. UK-based Absolute Antibody manufactures and sells more than 3,400 newly engineered–versions of recombinant antibodies. US-based Kerafast supplies over 3,500 reagents, such as antibodies, cell lines and proteins. In partnership with 159 institutes, Kerafast also develops and provides access to investigator-developed materials. "We believe all researchers should have access to recombinant versions of antibodies, especially those developed in academic laboratories that have been the bedrock of so much scientific research," stated Dr. Nicholas Hutchings, founder and CEO of Absolute Antibody. "Kerafast's strong existing relationships with research institutions will allow us to advance the creation and availability of recombinant antibodies." The companies stated that at this time they will retain their individual names and websites.

According to Absolute Antibodies, the company produces its recombinant antibodies using transient transfection, which results in faster production times and higher purity. The company announced last June that sales had grown 195% in the first two quarters, driven by custom services, with a catalog of 2,500 "off-the-shelf" products. The merger appears to give the company the ability to access researcher-developed content and additional distribution resources.

Fourth Quarter 2017 Results: Danaher, Illumina, PerkinElmer, Thermo Fisher Scientific, QIAGEN

CY Q4 2017 Results								
	Revenues			Rev. Growth Summary			Adj. Operating Profit	
Company	Rev. ($M)	% of Co. Rev.	Growth	Curr.	Acq./Div.	Org. Growth	($M)	% Growth
Danaher	$5,085.7	100%	10.9%	3%	3%	5%	$946.1	29.8%
Illumina	$659.0	100%	5.3%	0%	0%	5%	$244.1	56.9%
PerkinElmer	€641.6	100%	13.2%	3%	4%	6%	€97.4	1.9%
Thermo Fisher Scientific	$6,047.0	100%	22.1%	3%	11%	8%	$1,450.0	18.2%
QIAGEN	$396.9	100%	8.3%	3%	0%	5%	$121.7	8.0%

Life Science Lifts Danaher Growth

Q4 2017

In the fourth quarter of 2017, total sales for Danaher advanced 10.9% to $5.1 billion. Organically, total company sales rose 5.5%, driven by strong Life Science, Diagnostics and Environmental & Applied Solutions (EAS) growth. Currency effects added 3% to overall sales growth, while acquisitions boosted growth by 2.5%. Operating profit increased significantly, leaping 29.9% to $946.1 million, while operating margin rose 2.7 percentage points to 18.6%.

Selected Danaher Segments Q4 2017					
	Rev. ($M)	Rev. Growth	Curr.	Acq./Div.	Org. Growth
Life Sciences	$1,625.1	11.8%	3.5%	1.0%	7.3%
Environmental & Applied Solutions	$1,077.9	12.4%	3.0%	3.5%	5.9%

Fourth quarter 2017 Life Science segment (LS) sales increased 11.8% to $1,625.1 million, driven by better-than-expected sales of LS products, along with successful new product innovations. Organically, LS sales rose 7.3%, representing the segment's highest organic growth rate in more than four years. Segment operating margin was 20.0%, an increase of 312 basis points.

Beckman Coulter Life Sciences (BCLS) reported high single-digit organic growth for the second consecutive quarter. Organic growth for the business was primarily driven by continued strength in flow cytometry, along with strong particle counting product sales. Over the last three years, BCLS has launched around 20 new products, also driving sales growth.

Leica Microsystems delivered organic growth in the low-single digits, supported by moderate growth in Western Europe, along with strength in the medical and research end-markets. SCIEX MS sales grew in the mid-single digits, propelled by strength in the food, environmental and pharmaceutical end-markets.

Fourth quarter 2017 organic sales for Pall advanced nearly double digits, led by microelectronics and single-use technologies sales, along with increased strength in the biopharmaceutical and industrial end-markets.

For Danaher's EAS segment, fourth quarter 2017 revenue advanced 12.4% to $1,077.9 million, up 5.9% organically. Operating profit increased 8.1% to $248.6 million, while operating margin fell 91 basis points to 23.1% due to increased investment spending within the Water Quality business.

Organic sales for Hach grew mid-single digits, primarily driven by strength in the municipal and industrial end-markets, along with continued growth in China.

FY 2017

Danaher sales for full-year 2017 increased 8.6% to $18.3 billion. Organically, sales rose 3.5%, driven by overall strength, especially in Life Science and Diagnostics. Additionally, continued growth investments and good commercial execution contributed to overall sales growth. Operating profit advanced nearly double digits, up 9.8% to $3,021.2 million. However, operating margin increased just 20 basis points to 16.5% due to increased investment spending.

LS sales for the year increased 6.4% to $5,710.1 million, accounting for 31% of total company revenues. Operating profit grew significantly, up 22.6% to $1,004.3 million, the largest of all business segments. Operating margin rose 233 basis points to 17.6%, with LS as the only business segment to experience such an increase.

EAS recorded 2017 sales growth of 7.5% to $3,968.8 million, the third highest of sales among Danaher's segments. Operating profit grew moderately at 5.1%, reaching $914.6 million. EAS operating margin fell the least among the segments, sliding just 51 basis points to 23.0%.

As for first quarter 2018, organic sales growth is expected to be 3.5%–4.0%. For the full year, Danaher projects organic sales growth to be around the same, at 4.0%.

Double-Digit Growth for Illumina

Q4 2017

Illumina delivered fourth quarter 2017 sales of $778 million, an increase of 25.7%. The strong growth was a result of solid performances from the company's sequencing and array-related products. Sequencing instruments, as well as sequencing consumables, both exceeded expectations. Operating margin advanced 6.3 percentage points to 31.4%, also representing a 4.6 percentage point increase sequentially.

Illumina Q4 FY17			
	Rev. ($M)	% Rev. Growth	% of Rev.
Consumables	$514	26.3%	66%
Instrument	$139	21.9%	18%
Other Products	$6	50.0%	1%
Service & Other	$119	26.6%	15%

Microarray sales accounted for 16% of total company revenues, advancing 21.0% to $123 million. Additionally, direct-to-consumer demand also rose, increasing overall microarray sales. Microarray consumables delivered 8.0% growth to $82 million, while microarray instrument sales slid down to $8 million.

Sequencing sales for fourth quarter 2017 amounted to $655 million, representing 84% of total revenues. Sequencing instrument revenue, driven by a NovaSeq shipments, amounted to $131 million. NovaSeq shipments during the quarter surpassed 85, representing the highest amount shipped of all quarters in 2017. However, Illumina did not ship any HiSeq X systems in the quarter. As for sequencing consumables, sales increased significantly, ascending 31.0% to $432.0 million. NovaSeq and NextSeq consumables sales led the strong growth, contributing more than $100 million in sales.

Total Consumables sales vaulted 26.3% to $514 million. Consumables sales accounted for 66% of total revenues. Fourth quarter 2017 total Instrument sales leaped 21.9% to $139.0 million, accounting for 18% of total revenues. As such, total product revenue for the fourth quarter rose 26.0% to $659.0 million. Service & Other revenue also increased double-digits, up 26.6% to $119 million, driven by genotyping services and sequencing services. Increased consumer demand as well as instrument maintenance contracts also added to overall sales growth.

Geographically, the Americas delivered the fastest sales growth, up 32% due to strong growth in both sequencing instruments and consumables. The EMEA region also grew notably, increasing 25%. As for the Asia Pacific, sales advanced 9%, primarily driven by double-digit shipment growth in China.

FY 2017

Full-year 2017 revenue for Illumina advanced 14.8% to $2,752 million, driven by strong overall sales from all segments. Consumables and Services & Other, in particular, performed the strongest.

Illumina FYE 17			
	Rev. ($M)	% Rev. Growth	% of Rev.
Consumables	$1,753	13.6%	64%
Instrument	$515	9.8%	19%
Other Products	$21	5.0%	1%
Service & Other	$463	26.5%	16%

Illumina's clinical business continued to show growth in 2017, driven by oncology sales. Oncology sales were led by increased demand for therapy-selection and liquid biopsy products. As such, oncology testing shipments grew 40% in 2017.

Microarray sales for 2017 advanced 20.0%, driven by increased consumer samples processed throughout the year. Microarray consumables sales increased 5.0% to $285 million, while microarray instruments sales amounted to $31 million.

Full-year 2017 sequencing consumables sales increased 15.0% to $1,468 million, driven by a strong performance from NovaSeq and NextSeq. Sequencing instruments delivered notable growth, up 8.0% to $484 million, driven by NovaSeq sales. However, sales were partially offset by lower HiSeq shipments. For the year, NovaSeq shipments amounted to approximately 285, whereas in 2018, the company expects shipments between 330 and 350 systems.

For the first quarter, Illumina expects its total sales to be approximately $35 million lower than its sales from the fourth quarter. As for full-year 2018, the company expects total revenue to rise 13%–14%.

Diagnostics Drives PerkinElmer Expansion

Q4 2017

For fourth quarter 2017, PerkinElmer sales increased 13.2%, 6.0% organically, to $641.6 million, beating company expectations. Adjusted operating income rose 13.6% to $137.0 million.

PerkinElmer Q4 FY17						
	Rev. ($M)	% of Rev.	% Rev. Growth	Currency	Acq./ Div.	Org. Growth
Discovery & Analytical Solutions	$448.2	70%	9.3%	3%	0%	6.3%
Diagnostics	$193.4	30%	23.0%	3%	14%	5.0%

Fourth quarter 2017 Discovery & Analytical Solutions (DAS) sales increased 9.3%, 6.3% organically, to $448.2 million, driven by significant demand for the segment's environmental and food-related products, along with better-than-expected sales for pharmaceutical and biotech products and services. By end-market, industrial sales grew low-single digits, while academic sales fell low-single digits due to a tough prior year comparison. However, the company expects both end-market sales to recover and perform better in the first half of 2018. Adjusted operating income for DAS amounted to $93.7 million, an increase of 13.0%. Adjusted operating margin grew 70 basis points to 20.9%.

Diagnostics sales soared 23.0% to reach $193.4 million, driven by increased demand for reproductive health and applied genomics products. Organically, sales rose 5.0% as currency effects and acquisitions added 3% and 14% to sales growth, respectively. Adjusted operating income also increased double digits, up 23.7% to $59.5 million. Adjusted operating margin resulted in a 20 basis point increase to 30.8%.

Geographically, all major geographies delivered robust organic sales growth for the company, with Europe growing the fastest, up low double digits. Asia followed closely with high-single digit organic growth, whereas organic sales

growth in the Americas was in the low-single digits. In the BRIC region, organic sales growth continued to expand, driven by a strong recovery in Brazil, along with double-digit growth in China.

FY 2017

In 2017, full-year sales for PerkinElmer advanced 6.7% to $2,257.0 million. Organically, sales grew 4.4% as currency effects and acquisitions together added 2.3% to reported sales growth. Adjusted operating income increased 8.7%, delivering an adjusted operating margin of 18.9%.

PerkinElmer FYE 17						
	Rev. ($M)	% of Rev.	% Rev. Growth	Currency	Acq./ Div.	Org. Growth
Discovery & Analytical Solutions	$1,578.5	70%	4.3%	0%	0%	4.3%
Diagnostics	$678.5	30%	12.6%	1%	7%	4.6%

For full-year 2018, PerkinElmer expects sales growth to be 20%, representing revenues of $2.72–$2.74 billion. Organically, sales growth is expected to be 5%–6%. Additionally, revenue from EUROIMMUN is projected to generate $360 million in sales. As for the first quarter, total company revenues are expected to grow organically by mid-single digits, amounting to $615 million.

Geographically, PerkinElmer expects organic revenue growth in the Americas to be in the mid-single digits in 2018. As for the European region, the company also projects mid-single digit organic sales growth. Sales in Asia are expected to grow organically in the high-single digits.

Healthy Finish for QIAGEN in 2017

Q4 2017

Fourth quarter 2017 sales for QIAGEN advanced 8.2% to $396.9 million (see Bottom Line). On a constant currency basis, sales growth was 5.0%, excluding the approximate three percentage-point contribution from currency effects. Adjusted operating income grew 8.0% to $121.7 million, resulting in an adjusted operating margin of 31.0%.

QIAGEN Q4 FY17				
	Rev. ($M)	% Rev. Growth	% of Rev.	Rev. Growth (Excl. Currency)
Molecular Diagnostics	$193	4.3%	49%	4%
Academia	$92	13.6%	23%	5%
Pharma	$72	9.1%	18%	9%
Applied Testing	$40	14.3%	10%	9%

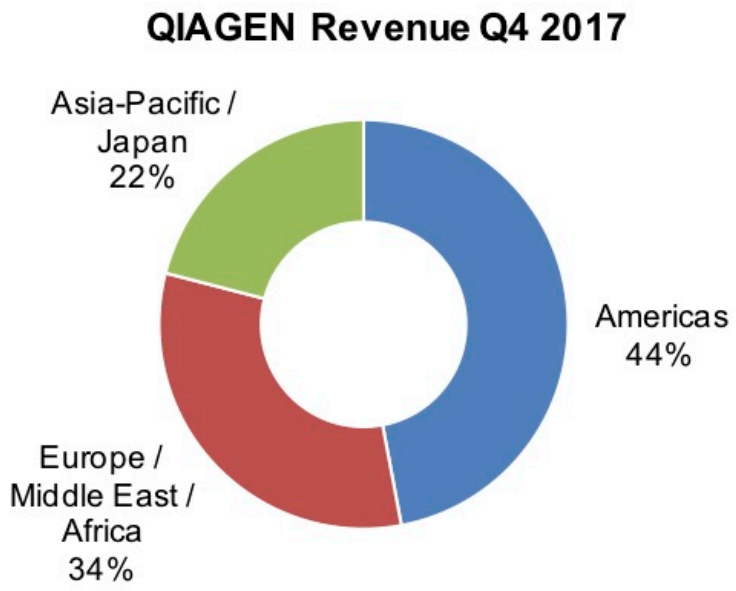
Molecular Diagnostics sales grew 4.3% to $193.0 million. Similarly, in constant currencies, sales growth increased by 4.0%. Segment sales accounted for nearly half of total company revenues.

Sales in Academia increased 13.6% to $92.0 million, accounting for 23% of total company revenues. On a constant currency basis, sales growth, however, reached just 5.0%. Academia growth was driven by double-digit sales increases for instruments, along with high-single digit growth for consumables.

Pharma sales experienced notable growth, advancing 9.1% to $72.0 million. Sales growth in constant currencies grew at the same rate, driven by double-digit growth for consumables and related products. However, growth was partially offset by weak instrument sales.

Applied Testing sales rose 14.3% to $40 million, driven by continued strength in human ID and forensics solutions demand. Sales increased 9.0% in constant currencies.

Geographically, the Americas accounted for 44% of total company revenues. Sales growth in the Americas advanced 7.0% in constant currencies, driven by strength in the US and Brazil. However, sales in Mexico declined double digits. In the EMEA region, constant currency sales growth reached 6.0%. EMEA sales accounted for 34% of total company revenues. Sales in the Asia Pacific and Japan region increased just 1%, in constant currencies. The APAC region represented 22% of total company revenues.



FY 2017

Full-year 2017 QIAGEN revenues advanced 6.1% on both a reported and constant currency basis to $1,419.0 million. Adjusted operating income rose 14.0% to $371.5 million, while adjusted operating margin rose two percentage points to 26.0%.

QIAGEN FYE 17				
	Rev. ($M)	% Rev. Growth	% of Rev.	Rev. Growth (Excl. Currency)
Molecular Diagnostics	$683	3.0%	48%	6%
Academia	$323	10.2%	23%	4%
Pharma	$276	5.3%	19%	7%
Applied Testing	$137	14.2%	10%	14%

Geographically, sales in the Americas rose 4.0% in constant currencies. Excluding US HPV test sales, region sales delivered 6.0% constant currency growth. The Americas accounted for 46% of total company sales. In the EMEA region, sales grew at a constant currency rate of 9.0%, accounting for 33% of total company sales. The Asia Pacific and Japanese region delivered constant currency sales growth of 7.0%, representing 21% of company sales.

For the full year of 2018, QIAGEN expects total company revenues to grow between 6% and 7% in constant currencies. Currency effects are projected to add 3%–4% to overall reported sales growth for the full year. As for the first quarter, the company expects revenues to grow 5% in constant currencies. Additionally, acquisitions are not expected to contribute to first quarter sales growth.

Lab Products & Services Lift Thermo Fisher Scientifc

Q4 2017

Thermo Fisher Scientific sales in the fourth quarter advanced 22.1% to $6,047.0 million, driven by strong sales from the Asia Pacific, specifically in China and South Korea. Organically, sales grew 8.0% as currency effects and acquisitions added 3% and 11% to sales growth, respectively.

Thermo Fisher Q4 FY17				
	Rev. ($M)	% Rev. Growth	% of Total Rev.	% Organic Growth
Life Sciences Solutions	$1,578.0	11.2%	25%	8%
Analytical Instruments	$1,414.0	16.2%	22%	11%
Specialty Diagnostics	$914.0	9.6%	14%	7%
Laboratory Products & Services	$2,401.0	42.8%	38%	9%

By end-market, pharmaceutical and biotech sales growth rose double digits, up 10% due to strong performances from the bioproduction and clinical trial businesses. In the academic and government end-market, sales advanced in the high-single digits, driven by overall strength in most geographic regions, along with increased demand for MS and electron microscopy systems. In the diagnostics and healthcare end-market, sales delivered high-single digit growth, largely driven by solid demand for biomarker test products. As for the industrial and applied end-market, sales growth hit mid-single digits due to strength across a variety of businesses.

Life Science Solutions (LS) sales increased 11.2% to $1,578.0 million, driven by strength in the bioproduction and biosciences businesses. Organically, sales rose 8.0%. Adjusted operating margin for the segment advanced 270 basis points to 35.6%.

Analytical Instruments (AI) sales grew double digits, up 16.2% to $1,414.0 million, primarily driven by overall strength in all areas of businesses. Organic growth also excelled, up 11.0%. Adjusted operating margin was flat, however, at 24.5%.

Laboratory Products & Services sales experienced significant growth, accelerating 42.8% to $2,401.0 million. The company’s channel business, along with its clinical trials and logistics business, contributed to the strong growth. Organically, however, sales growth remained in the single digits at 9.0%. Segment sales accounted for the majority of total company sales for the quarter, at 38%. Adjusted operating margin fell 150 basis points to 12.5%.

Geographically, sales in North America advanced in the high single digits, growing at a pace just below Asia Pacific’s, where sales were up in the low teens. Asia Pacific’s double-digit sales growth was primarily driven by China’s high-teen sales growth. As for the European region, sales grew mid-single digits.

FY 2017

Full-year 2017 sales for Thermo Fisher increased 14.5% to $20.9 billion as a result of significant sales growth from the Analytical Instruments and Laboratory Products & Services segments. Currency effects contributed little to sales growth, but acquisitions added 9.0%. Organic sales growth for the year amounted to 5.0%.

Thermo Fisher FYE 17				
	Rev. ($M)	% Rev. Growth	% of Total Rev.	% Organic Growth
Life Sciences Solutions	$5,728.0	7.7%	26%	6%
Analytical Instruments	$4,821.0	31.4%	22%	9%
Specialty Diagnostics	$3,486.0	4.4%	16%	4%
Laboratory Products & Services	$7,825.0	16.4%	36%	5%

By end-market, pharmaceutical and biotech sales advanced high-single digits, driven by strong growth across all of the company's businesses. The academic and government end-market delivered mid-single digit sales growth, while industrial and applied sales increased mid-single digits as well, driven by the chemical analysis business.

Geographically, sales in the Asia Pacific grew double digits, whereas sales growth for the rest of the world remained in the mid-single digits. High-growth regions, including China, India and South Korea, represented 21% of total company sales. China delivered high-teen sales growth, accounting for 10% of total company sales. Additionally, Thermo Fisher's e-commerce sales in China vaulted 50% for the year. Thermo Fisher expects China to continue delivering the fastest growth rate among all the major geographies.
Life Science Solutions (LS) sales grew 7.7% to $5,728.0 million. Organically, LS sales rose 6.0%. LS adjusted operating margin increased to 33.1%, a gain of 310 basis points. Sales for Analytical Instruments (AI) leaped 31.4% to $4,821.0 million, an increase of 9.0% organically. AI adjusted operating margin grew one percentage point, finishing the year at 21.3%. Laboratory Products & Services (LPS) revenue grew 16.4%, 5.0% organically, to $7,825.0 million. LPS adjusted operating margin, however, fell 1.5 percentage points to 12.9%.

For full-year 2018, Thermo Fisher expects revenues to be between $23.42 billion and $23.72 billion, indicating a 12%–13% increase. Organically, full-year sales growth is expected to be around 4%–5%. Currency effects and acquisitions are projected to add 1% and 7% to reported sales growth, respectively.

Nano LC

Nano LC is a common technique in proteomic research. It is a miniaturized HPLC technique developed for analyzing biological samples. The low sensitivity of conventional HPLC coupled with a high flow rate, which is not compatible with ESI-MS, make this common technique unsuitable for biomolecular analysis. Therefore, this lower flow-rate chromatography technique is designed to achieve greater analytical sensitivity with a smaller sample size, making nano LC suitable for biomolecular analysis.

The name "nano LC" refers to the flow rate of the mobile phase, which is in the nanoliter per minute range. The typical flow rate for these systems is between 10 nL/ min and 1,000 nL/min with column inner dimension (ID) ranges of 10–100 µm. A nano LC system consists of the same components as a standard HPLC system, with a downscaled injector, pump, tubing and detector due to the reduction of column ID. The small column ID offers minimum sample waste and higher peak capacity compared to regular HPLC. Nano LC systems are usually coupled with an MS detector, which enables high-sensitivity analysis for minute or diluted samples.

Nano LC typically employs manually packed capillary columns to analyze samples. However, it is often difficult and time consuming to do in-house column packing. The particles have to be of the same diameter to avoid undesirable void volumes. In light of the difficulties observed in self-packed columns, some nano LC devices are now integrated with microfluidic chip technology that utilizes a weir structure for retaining stationary phase particles and eliminating dead volume.

Aside from academic research applications, especially in proteomic analysis, nano LC systems also find applications in the pharmaceutical and biotechnology industries. This technology is essential in exploring the interaction between proteins and drugs. Pharmaceutical R&D utilizes nano LC's proteomics-related capability in the analysis of therapeutic proteins and drug efficacy. Protein identification is also crucial in bioprocess optimization and

agricultural genetic improvements. Overall, demand for nano LC will be buoyed by basic research advancements in academia, as well as the pharmaceuticals and biotechnology industries.

The global nano LC market was estimated to be over $200 million in 2017, with a projected mid-single digit growth rate in 2018. The market is populated with big players such as Waters and Agilent Technologies, which offer nano-micro versions of their HPLC/UHPLC systems. Waters leads the market with its ACQUITY UPLC M-class system with multidimensional-analysis functionality. Thermo Fisher Scientific also has a major presence in the market through successful acquisitions that have expanded its nano LC portfolio. SCIEX (Danaher) is another strong competitor with its NanoLC 400 and nano cHiPLC columns, which employ microfluidic chip technology.

With growing biopharmaceuticals research in Europe and the US, demand for nano LC will continue to grow moderately. In addition, China is also preparing itself to be a global biotech hub, resulting in a stream of foreign investments and contract research services flowing into the country. Nano LC has also become a more environmentally friendly alternative to the conventional HPLC system thanks to its small sample requirement. Running a smaller sample reduces operating costs and chemical waste. However, the high initial system price might inhibit growth in demand, especially in developing regions.

Leading Vendors:

- Waters
- Agilent Technologies
- Thermo Fisher Scientific

Largest Market:

- Academia
- Pharmaceutical
- Biotech

Instrument Cost:

- $55,000–$100,000

Genomics

Earlier this week, the NIH's National Human Genome Research Institute (NHGRI) launched a roadmap aimed at producing a new strategy for expanding genomics research and applications by October 2020, coinciding with the 30th anniversary of the launch of the Human Genome Project. The roadmap will involve stakeholders, nonprofit organizations, private sectors, patient groups, thought leaders in the scientific and medical industries, and the public.

The NHGRI plans to focus on less-developed areas of genomics, as well as areas that are not specific to diseases or physiologies, and applications that will benefit greatly from large investments. This includes developing technological innovations for genomics, using genomic data in clinical care, analyzing genomic variation, monitoring genomic activity in interaction with its environment, developing genomic policy, and examining the legal, social and ethical implications of genomics. Areas that have already been established and well-funded in the past will be less explored, such as cancer and microbial genomics.

The new strategy will focus on five categories: basic genomics and genomic technologies; genomics of disease; genomic and precision medicine; genomic data science; and society, education and engagement.

Source: *National Human Genome Research Institute*

Chemicals

The National Toxicology Program, part of the US Department of Health and Human Services, announced a new strategic roadmap last month, prepared by the Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM). The roadmap was established for the purpose of providing federal agencies and industry stakeholders alternative approaches for the safety and risk assessment of chemicals and medical products that improve human health or offer replacements for animal testing.

The roadmap puts forth three main goals, all of which focus on connecting end-users with New Approach Methodologies (NAM). The first goal addresses the fact that traditional commercialization of technologies happens after the product is already developed; ICCVAM posits that regulatory agencies and regulated industries should work in tandem with technology developers to identify potential testing requirements, as well as help improve communication between end-users and researchers.

Establishing efficient and adaptable practices for the purpose of inciting confidence in NAMs is the second goal of ICCVAM. Through partnerships, ICCVAM encourages industry stakeholders and government agencies to again work together with creators of NAM, remaining engaged in the development process from inception to ultimate use. This includes establishing public-private partnerships in which data and knowledge will be shared, and a collective pool of resources can be centralized and, therefore, easily accessible.

ICCVAM's third goal is to facilitate successful adoption of NAMs in the US and abroad. This would require federal agencies and stakeholders to collaborate with international partners, creating incentives to bolster widespread usage of NAMs, and creating metrics to establish project goals, to monitor progress and to quantify the success rate of NAM implementation.

Source: *National Toxicology Program*

Government

The Trump administration has officially suspended the Obama-era Waters of the United States rule as part of a process to rescind the rule all together and replace it with a new, industry friendly version. The 2015 rule detailed clean water regulations and limited the use of chemical fertilizers and other pollutants that could seep into small streams, limiting pollution in approximately 60% of the US' bodies of water. While federal protections existed for large bodies of water, such as the Chesapeake Bay and Puget Sound, the Waters of the United States rule extended the protections to the smaller bodies of water that flow into larger ones, including rivers, waterways and wetlands. The rule was widely contested by rural landowners that make up a significant portion of Trump's base, and repealing and replacing the rule was a key part of Trump's campaign.

The Trump administration is working on a new rule that will ensure more lax regulatory requirements for rural landowners, with a draft proposal scheduled for this spring and a new finalized rule later this year.

Source: *The New York Times*

India

The Indian government released its federal fiscal budget for 2018-19 earlier this month. The budget bill pushes greater increases for internet technology and health care systems, while funding for basic science remained flat or experienced nominal increases.

The Ministry of Chemicals and Fertilizers' Department of Chemicals and Petrochemicals will receive INR 199.7 million ($3.1 million), a major decrease of 68.5%. The budget for the Department of Pharmaceuticals, also a part of the Ministry of Chemicals and Fertilizers, will stay flat at INR 261.5 million ($4.1 million).

A section of the Ministry of Consumer Affairs, Food and Public Distribution, the budget for the Department of Food and Public Distribution's budget increased nominally to INR 1.7 trillion ($27.3 billion), while the Ministry of Food Processing Industries' budget remained flat at INR 14.0 billion ($22 million).

The budget for the Ministry of Health and Family Welfare's Department of Health Research also remained flat at INR 18.0 billion ($28.2 million). The Ministry of New and Renewable Energy had its budget increase nominally to INR 51.5 billion ($80.7 million), while the budget for the Ministry of Petroleum and Natural Gas jumped 13.5% to INR 311.0 billion ($487.9 million).

Science funding also remained largely flat, with the Ministry of Science and Technology's Department of Biotechnology remaining the same at INR 24.1 billion ($37.8 million), and the Department of Science and Technology's budget rising just 1.3% to INR 51.1 billion ($80.2 million). The budget for the Department of Scientific and Industrial Research also increased nominally, not even 1%, to INR 48.0 billion ($75.2 million).

Source: *Ministry of Finance, Government of India*

EU

A consortium of European life scientists from 10 life science institutes have established Alliance4Life, a new initiative aimed at increasing research excellence in Central and Eastern European countries. The project hopes to uncover the fundamental causes of the discrepancies in health research and innovation between the older (Western) and more recently joined (Central/Eastern) EU member states. The consortium has two years to develop recommendations on how to improve health research and innovation in the region, as well as on how to advance research conditions.

Some issues plaguing the state of the health research industry in Central and Eastern Europe include nepotism, a lack of openness and transparency, and subpar management. For example, despite the talent and knowledge of a scientist in Central or Eastern Europe, unless they have the "right" connections, they will likely not be able to get their projects funded. Alliance4Life also aims to improve the reputation profiles of research institutions in Central and Eastern Europe as a means to appeal to more specialized workers.

The project will develop a list of indicators that will be used as benchmarks to compare Western EU countries with institutions in Central and Eastern Europe. Alliance4Life will also establish an international school of research management to provide key training to mid- and top-level managers at research institutes. The consortium hopes that the results of the Alliance4Life recommendations will positively impact that EU's next funding program, which will begin in 2021.

Source: *Horizon*

China

According to a report recently released by the NSF, China is positioned to become the world leader in science and innovation by 2050. Although the US still leads in scientific activity, the country's share of contributions is declining compared to China. The number of science and technology graduates in China is rising at an unprecedented rate, faster than in any other country, and China's R&D expenditures trail only behind the US. For example, in 2015, the US' R&D expenditures totaled $496 billion for a share of 26% of the world's total; in comparison, China's 2015 R&D expenditures totaled $409 billion, 21% of the world's total. Between 2000 and 2015, China's R&D expenditure grew 18% per year; in contrast, the US' R&D expenditure grew only 4.2%.

In a set of guidelines released by China's State Council at the end of January, the Chinese government plans to invest in the construction of new state laboratories for moonshot research, to focus on training young scientists and to increase collaborations with international scientists. The guidelines stated that support for basic science is imperative to reach these goals.

Source: *Research

Broad-based Companies

Company Announcements

The **Tennessee Department of Economic and Community Development** announced in December 2017 that **Agilent Technologies** plans to expand its Memphis-based distribution center, adding 100 new positions. The center serves North American and Central America.

In December 2017, **bioMérieux** appointed Alexandre Mérieux as chairman and CEO. He previously served as deputy CEO. Former CEO Jean-Luc Bélingard remains on the Board.

Hach, a **Danaher** company, acquired **Kipp & Zonen** in December 2017. Kipp & Zonen manufactures and distributes instruments for measuring solar radiation and atmospheric properties. The business will join the **OTT Hydromat** business.

In December 2017, **Bruker** announced the merger of its Japanese subsidiaries, effective January 1.

Metrohm USA opened a new 90,000 ft^2 (8,361 m^2) headquarters in Riverview, Florida, in January. The location includes a 25,000 ft^2 (2,323 m^2) warehouse.

Agela Technologies opened a new 11,840 ft^2 (1,100 m^2) administrative office in China in November 2017. The office has the capacity for 100 staff.

Phenomenex announced in January that it has acquired **Agela Technologies** (**Bonna-Agela**), which will provide Phenomenex products in China

In January, **Agilent Technologies** named Dow R. Wilson, CEO of **Varian Medical Systems**, to its Board, effective March 20.

In January, **Agilent Technologies** awarded biotech startup **Angiex** an Agilent Golden Ticket at **LabCentral**, a shared lab workplace, providing funding of one lab bench space for a year.

In January, **Agilent Technologies** announced a strategic scientific collaboration with the **University of Southern California Michelson Center for Convergent Biosciences** to create the Agilent Center of Excellence in Biomolecule Characterization. The agreement includes a collaboration with principal investigator Dr. Valery Fokin, whose lab focuses on chemical reactivity and biological interactions at a molecular level.

Agilent Technologies announced in January a partnership with the **Science Exchange**, an enterprise platform for outsourced R&D services. The partnership includes the Agilent–Science Exchange portal that allows Agilent customers to search and request a quote for Agilent-enabled research services directly from Agilent.com.

In February, **Agilent Technologies** announced a collaboration with the **Doping Control Center** in Seoul, South Korea to test urine samples during the **Olympic Games**. The Center is expected to run four thousand tests.

Porvair announced in January that it will form three new reporting segments in 2018, including a new Laboratory Group, which will consist of **Seal Analytical**, **Porvair Sciences**, **JGF** and **Rohasys**. The division will account for about 30% of revenues.

GE announced on its fourth quarter 2017 conference call that Life Sciences revenue increased 5% during the quarter. Life Sciences orders grew 4% on an organic basis during the quarter, with bioprocess orders up 2%. Life Sciences orders grew 9% organically in 2017, driven by a 12% increase in bioprocess orders.

In January, **Renishaw** named William Lee as chief executive, effective February 1. Mr. Lee was previously Group Sales and Marketing director. Former CEO Sir David McMurtry remains executive chairman.

Danaher announced that Matthew R. McGrew will succeed Daniel L. Comas as CFO, effective January 1, 2019. Mr. McGrew is currently CFO of the company's Diagnostics and Dental platforms.

In January, **Diploma** announced that Richard Ingram will join its Board as CEO designate, effective April 23. Mr. Ingram was previously president of **Smiths Detection**.

Thermo Fisher Scientific announced in January that as result of the US federal tax reform it will pay a one-time $500 bonus to all employees, totaling $34 million. In addition, as a result, the company plans to invest $16 million investment in R&D, sustainability initiatives and philanthropic activities in support of STEM (Science, Technology, Engineering and Math) education.

QIAGEN named Jonathan Sheldon, PhD, as senior vice president, head of Bioinformatics Business Area and member of the Executive Committee, effective February 1. He previously led **Oracle**'s Health Sciences Global Business Unit.

Endress+Hauser opened a third plant, measuring16,500 ft^2 (1,533 m^2), in China in January in Suzhou. The company has more than 420 employees in the country, including 100 **Analytik Jena** employees.

Sartorius was promoted by **Thermo Fisher Scientific** to Platinum supplier status in Europe in February.

Roper Technologies named Neil Hunn as COO in February. He remains executive vice president.

Mettler-Toledo's fourth quarter 2017 Lab revenue rose 11% in local currency, including 1% growth from the acquisition of **Biotix** (see ***IBO*** 11/15/17), or 9% organic growth. Growth for the quarter was broad based. In China, it was the seventh consecutive quarter of double-digit growth, according to the company's quarterly conference call. For the full-year 2017, Lab sales increased 10.9% in local currency, including 2% growth from acquisitions, to make up 50% of company sales (see Bottom Line), or $1,362.5 billion.

Mettler-Toledo disclosed in its 2017 **SEC** 10-K filing that Peter Aggersbjerg was named head of the Laboratory business in January. He was previously head of our Laboratory Weighing strategic business unit.

Liquid Chromatography

Company Announcements

In November 2017, **Repligen** extended its long-term supply agreement through 2022 with **Purolite Life Sciences** for the manufacture of Protein A ligands. Repligen is the main strategic supplier of Protein A ligands to Purolite Life Sciences. Purolite Life Sciences will use and promote Repligen's OPUS technology for end-to-end solutions for the downstream purification of biologic drugs, specifically monoclonal antibody–based biologics. Purolite Life Sciences provides the Praesto Protein A affinity and ion exchange agarose resins. The companies have been partners since 2015.

PharmaFluidics, which makes the mPAC micro-chip chromatography columns, announced in January that it has raised €7.3 million ($8.7 million) in its most recent financing round.

In January, **Waters** entered into a comarketing agreement with **Malvern Panalytical**, which pairs their respective ACQUITY Advanced Polymer Chromatograph System and OMNISEC REVEAL multidetector module for improved characterization. The combination allows for the calculation of absolute molecular weight, intrinsic viscosity and hydrodynamic radius.

In February, **Akzo Nobel**, whose Specialty Chemicals business supplies Kromasil brand LC columns and media, announced that it has completed the internal separation of its Specialty Chemicals division and expects to complete a sale or demerger of the division by April.

Product Introductions

YL Instruments introduced in November 2017 the YL9100 Plus HPLC, featuring an improved quaternary pump and the new YL9150 Plus LC Autosampler.

Restek launched in December 2017 a 1.8 mm particle size for its Raptor superficially porous particle columns. The column is available in four phase chemistries.

In January, **Bio-Rad Laboratories** debuted the NGC Fraction Collector for its NGS Chromatography System. The product provides for the flexibility and collection capacity needed for any application, from discovery to scale-up.

Waters unveiled in January the BioResolve RP mAb Polyphenyl 450 Å 2.7 mm solid core columns intended for reversed phase analysis of intact or sub-unit-digested mAbs and antibody drug conjugates using LC/UV and LC/MS. The product line includes application-focused standards, template methods and enhanced levels of application support.

In January, **Waters** launched the Waters ACQUITY Arc Bio System, a versatile, iron-free, bio-inert, quaternary LC specifically engineered to enable the efficient transfer and improvement of bioseparation analytical methods regardless of the LC platform on which the original method was developed.

Life Science Instruments

General Life Science Instruments

Company Announcements

Clearbridge Health's SAM Laboratory announced in November 2017 that it will become the exclusive provider of **Nanostring Technologies**' Prosigna Breast Cancer Prognostic Gene Signature Assay in Singapore, Malaysia, Indonesia and the Philippines, and a nonexclusive supplier throughout Asia.

In January, **Nanostring Technologies** announced a partnership agreement with **Riken Genesis**, a **Sysmex** subsidiary, to commercialize nCounter-based companion diagnostics assays in Japan, including its lymphoma subtyping test.

Nanostring Technologies named Thomas Bailey as CFO, effective January 16. He previously served as CFO for medical technology firm **AgaMatrix**.

In November 2017, **Nano Global** announced the development of a system-on-a-chip-based technology licensed from **Arm**. The chip will be used to capture and analyze molecular data in real time.

In February, **Scientific Digital Imaging** acquired the assets, stock, designs and trademarks of **Quantum Scientific** (QSI), a designer and manufacturer of high-quality scientific cameras, for $350,000.

Product Introductions

In December 2017, **Syngene** introduced the new GeneGnome XRQ chemiluminscence imaging system for Western blots. The software enables single or multi-image capture with different exposure times simultaneously.

Gene-based Analysis

Company Announcements

Sphere Fluidics announced in November 2017 the receipt of a €1.6 million ($1.9 million) grant from **Eurostars** to develop a large DNA cargo delivery and genome engineering system based on its Cyto-Mine Single Cell Analysis System (see SLAS 2018: Companies Unveil New Platforms).

Molecular Biology System announced in December 2017 that **AMPLITECH** will distribute its NEXTGENPCR thermal cycler in France and Switzerland.

In December 2017, **GenDx** signed a reseller agreement for **Thermo Fisher Scientific**'s Applied Biosystems QuantStudio real-time PCR systems. The systems are compatible with GenDx's reagents and software for monitoring the chimeric status of bone marrow and stem cell receipients.

Meso Scale Discovery announced in January **FDA** 510(k) clearance of its conventional C-reactive protein assay for IVD use on the MESO SECTOR S700 system.

In February, **OpGen** entered into a global supply agreement to use **Thermo Fisher Scientific**'s real-time PCR technology in its Acuitas AMR Gene Panel Tests. The first test, a research-only test, is the AMR Gene Panel u5.47 for infection control and pharmaceutical surveillance. It wil employ Thermo Fishers' TaqMan Fast Advanced Master Mix, TaqMan Probes and QuantStudio 5 Real-Time PCR System.

Product Introductions

In December 2017, **JN Medsys** launched the Clarity Plus+ digital PCR system, with more than 40,000 partitions per reaction and 4–6 color detection channels. The latest system provides more partitions and the ability to detect up to 384 or 576 different targets per run. Shipments begin in the second quarter.

In February, **Quantabio** launched the portable, compact, affordable Q cycler, which can process up to 48 samples and yields results in as little as 25 minutes. It is available in 2- or 4-channel models.

Bionano Genomics released in February a new chemistry for sequence motif labeling, Direct Label and Stain, for its genome mapping technology. Features include single-variant resolution down to 500 pb and a more streamlined workflow than the previous chemistry.

Cell-Based Instruments

Company Announcements

IsoPlexis announced in November 2017 receipt of $5.6 million in total funding, including four new grants from the **NIH**. The company's IsoCode Chip detects cellular responses at the single-cell level.

In November 2017, the **European Commission** awarded €2.1million ($2.5 million) to **Phase Holographic Imaging** (PHI), **BAM** and **Malmö University** for a three-year project to develop improved methods for detecting cancer. PHI will have rights to commercialize the technology. PHI provides time-lapse cytometry instrumentation and software.

Symcel announced in November 2017 that it has secured €3.6 million ($4.2 million) in **Horizon 2020** funding as part of a consortium to support its evaluation of improved combination testing of antibiotics against drug-resistant bacteria in sepsis patients. The company's calScreener technology measures the metabolism of bacteria.

NanoCellect Biomedical raised $10 million in Series B funding in November 2017. The financing was led by **Illumina Ventures** and included participating investor **Agilent Technologies**, as well as other investors. NanoCellect Biomedical is developing the WOLF Cell Sorter for cell-based assays.

ACEA Biosciences announced in November 2017 a development and comarketing agreement with **Ncardia** to provide solutions for cardiac drug discovery and cardiac safety assessment. Under the agreement, ACEA Biosciences' xCELLigence Real-Time Cell Analysis Cardio and CardioECR instruments are coupled with Ncardia's Pluricyte andCor.4U human ISPC-derived cardiomyocytes.

In December 2017, **Phasefocus** named **Nuohai Life Sciences** as a distributor for China, Hong Kong and Macau.

Cell Microsystems announced in December 2017 that its CellRaft Technology that was previously available exclusively through **QIAGEN** is now available from multiple vendors. The system enables efficient sorting and isolation of single cells under standard culture conditions.

In January, **Pfizer** entered into a research and collaboration agreement to optimize **Berkeley Lights**' Beacon Optofluidic platform with the goal of accelerating mAb discovery and gene editing workflows.

Cell Microsystems received a $1.5 million grant in January from the **NIH**'s Small Business Innovation Research program for development of the AIR-FLOW instrument for single-cell RNA-seq. The company has been awarded $6.8 million in NIH funding since February 2016. In 2017, company sales rose 67% to $2 million and it was profitable. The company's CellRaft Technology enables high-efficiency sorting and isolation of single cells under standard culture conditions

In January, **Sphere Fluidics** announced the opening of a sales and support operation in New Jersey, which expands its North American presence.

Militenyi Biotec announced that it is part of the **PiCoP** (Peptide-based Immunization strategy for treating Colorectal and Pancreatic cancer) project, which has received a €4.6 million ($8 million) grant from the German State of Mecklenburg-Vorpommern to develop a novel cell therapy to teach immune cells how to fight cancer.

Product Introductions

In January, **Biolog** introduced the MitoPlate S-1 and MitoPlate I-1 for use with its Biolog OmniLog instrument for comprehensive scanning of mitochondrial function.

In February, **Takara Bio USA** launched the SMARTer ICELL8 cx System, a high-throughput single-cell automation system. It includes a built-in imaging station and software analysis tool. The company also announced the SMART-Seq full-length transcriptome analysis technology for the system.

Sales and Orders of Notes

MILabs announced in November 2017 the installation of its VECTor5 Hybrid OI/CT in vivo animal imaging system at the Institute of **Biomedical and Pharmaceutical Sciences at Guangdong University of Technology** in China.

Berkeley Lights announced in November 2017 that **Teva Pharmaceuticals Australia** implemented its Beacon platform for antibody discovery.

In January, **Berkeley Lights** announced the implementation of its Beacon optofluidic platform by **Novartis** for antibody discovery. Novartis was an early adopter of the technology and has now accepted the platform.

Berkeley Lights announced in January that **Shire** has purchased its Beacon optofluidic patform to accelerate its cell line–development process.

In November 2017, **Aenitis Technologies** received €4 million ($5 million) in funding as part of Phase 2 European program, part of **Horizon 2020**, to develop its Acoustic Blood Cell Sorter.

Protein-based Analysis

Company Announcements

In January, the **Centre for Process Innovation** announced a consortium to develop a novel analytical platform to improve the rapid analysis of the glycosylation profiles of biotherapeutics. The other members are **GlycoSeLect**, **ForteBio Pall Life Science** and **Allergan Biologics**. The new technology will serve as an alternative to LC/MS analysis.

Carterra announced in January that it has raised $10 million in financing to develop its LSA instrument, a fully automated, high-throughput mAb characterization platform based on its label-free biosensing technology.

Product Introductions

In December 2017, **Nanomedical Diagnostics** released the new Getting Started Kit, a self-training package for its Agile R100 assay platform and Field Effect Biosensing technology. The Kit can be completed by a new user in four hours at a personal benchtop.

SCIEX launched in January the CE-based C100HT system for qualitative glycan screening for decisions in clone selection and cull culture optimization. The system includes an assay kit configured for up to one thousand separations and a 12-capillary reagent cartridge. An analysis dashboard enables pass/fail results to be viewed at a glance. It comes with a mobile lab bench. Ninety-six samples can be prepared in less than two hours.

Sales and Orders of Note

Creoptix announced in November 2017 that lead discovery company **leadXpro** selected its WAVEdelta system for membrane-protein drug discovery projects. The Wave technology utilizes real-time label-free molecular interaction analysis.

In January, **Bio-Techne** announced that contract research testing service **BioAgilytix** has added its ProteinSimple-branded ELLA immunoassay platform to support multiplex biomarker analysis in cases where assay variability and antibody cross-reactivity are of particular concern.

Molecular Spectroscopy

Company Announcements

B&W Tek announced in November the addition of its TacticID handheld Raman spectrometer onto the US **General Services Administration** Schedule 84 through its distributor **Safeware**.

In December 2017, **PerkinElmer** announced a collaboration with **TeakOrigin**, a company integrating technology and data platforms to serve as a detector for food authenticity and quality. The firms aim to develop a first-of-its-kind technology that uses a single platform to analyze a number of food types for key indicators that determine authenticity, quality and freshness. The research will leverage molecular spectroscopy, UV-Vis, mid-IR, NIR and Raman spectroscopy. The pilot testing will be for olive oil, honey and applies. In the future, the companies aim to develop and validate new handheld spectroscopic devices and chemometric models.

In February, **Ocean Optics**, a **Halma** company, announced a partnership with **Pyreos**, a supplier of thin film PZT phyroelectric sensors, to develop an ultra-fast, compact mid-IR ATR reflectance system. The first product, an OEM product for counterfeit food detection, is expected to debut in the first half of this year.

Product Introductions

WITec started shipping in November 2017 the Suite FIVE data acquisition, evaluation and processing software with the new ability to compensate for thermal and mechanical variations during long-term measurements.

Sage Analytical introduced in November 2017 the next generation Profiler II—Humboldt Special Edition for accurate measurements of THC and CBD within seconds.

In November 2017, **CRAIC Technologies** launched the Apollo II Raman microscpectrometer for routine research. It can be added to the company's 20/30 PV microspectrophotometer, allowing Rman microspectra to be collected in addition to UV-Vis-NIR absorbance, reflectance and photoluminescence microspectroscopy, and imaging.

Rigaku Analytical Devices announced in December 2017 a library update to the software for its Progeny ResQ 1064 nm handheld Raman analyzer giving users the ability to identify more opioids, including various fentanyl compounds.

In January, **Wasatch Photonics** debuted the Cobra-S optical coherence tomography spectrometer, with a speed of 250,000 lines per second.

In January, **X-Rite** introduced the MetaVue VS3200 spectrophotometer, calling it the first non-contact instrument for industry applications that combines color imaging with spectrophotometry. Applications include testing in the plastics, coatings, cosmetic and food industries. It features an adjustable aperture size of 2–12 mm for measuring a

wide range of samples.

In January, **TSI/ChemiLogix** announced the integration of its Raman spectroscopy instruments with Spectragryph software. Spectrogryph is a universal interactive optical spectroscopy software developed by **Spectroscopy Ninja**.

TOPTICA launched in January the TeraFlash Imaging Extenstion for its TeraFlash time-domain spectroscopy platform, features faster measurements, with the acquisition of complete waveforms at up to 16 pixels/sec.

In January, **Thermo Fisher Scientific** unveiled the newly designed Thermo Scientific GENESYS UV-Vis spectrophotometer family, available in four models, optimized for usability and performance. Also launched was a new line of accessories.

Wilmad-LabGlass introduced in February its Benchtop NMR Tubes, which are produced specifically for 43 MHz, 60 MHz, and 80 MHz benchtop spectrometers with manual sample loading. They are available in 7 in and 8 in tube lengths.

In February, **HORIBA Scientific** launched the Duetta fluorescence/UV-Vis spectrofluorometer, featuring Absorbance-Transmittance Fluorescence Excitation Emission Matrices. The addition of absorbance simultaneously collects another molecular parameter (color) and the absorbance enhances the usable concentration range of fluorescence measurements. Scan speed is 510,000 nm/min, and wavelength range is 250–1100 nm.

Sales and Orders of Note

In December 2017, contract testing service **SSCI**, part of **AMRI**'s Global Analytical Services, announced it will expand its NMR capabilities with the addition of the **Bruker** AVANCE NEO 600 MHz NMR spectrometer. The system will be operational in late 2018.

Reported Financial Results

$US	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Agilent Technologies	Q1	31-Jan	$1,211.0	13.5%	$239.0	16.0%	$216.0	25.6%
Agilent Tech. (Life Sciences & Applied)	Q1	31-Jan	$618.0	14.4%	$159.0	26.2%	NA	NA
Agilent Tech. (Diagnostics & Genomics)	Q1	31-Jan	$185.0	12.8%	$22.0	-4.3%	NA	NA
Agilent Tech. (Agilent CrossLab)	Q1	31-Jan	$408.0	12.4%	$88.0	18.9%	NA	NA
AMETEK	Q4	31-Dec	$1,143.1	17.5%	$229.6	32.5%	$238.5	118.6%
AMETEK (Electronic Instruments)	Q4	31-Dec	$741.5	20.4%	$191.1	35.5%	NA	NA
AMETEK	FYE	31-Dec	$4,300.2	12.0%	$915.1	14.1%	$681.5	33.1%
AMETEK (Electronic Instruments)	FYE	31-Dec	$2,690.6	14.0%	$677.5	17.3%	NA	NA
Becton, Dickinson	Q1	31-Dec	$3,080.0	5.4%	$230.0	-71.6%	($174.0)	NM
Becton, Dickinson (Life Sciences)	Q1	31-Dec	$1,045.0	9.1%	$316.0	59.6%	NA	NA
Bio-Techne	Q2	31-Dec	$154.2	17.0%	$24.1	35.0%	$48.8	554.2%
Bio-Techne (Biotechnology)	Q2	31-Dec	$101.4	18.0%	$46.2	17.1%	NA	NA
Bio-Techne (Protein Platforms)	Q2	31-Dec	$29.4	36.4%	$6.1	232.0%	NA	NA
Bruker	Q4	31-Dec	$530.5	12.8%	$93.7	21.8%	$79.8	8.3%
Bruker (Scientific Instruments)	Q4	31-Dec	$484.3	11.3%	$96.9	31.7%	NA	NA
Bruker	FYE	31-Dec	$1,765.9	9.6%	$214.7	21.2%	$78.6	-48.8%
Bruker (Scientific Instruments)	FYE	31-Dec	$1,583.9	6.1%	$208.6	23.5%	NA	NA
Fluidigm	Q4	31-Dec	$27.7	445.7%	($8.7)	50.6%	($10.5)	40.9%
Fluidigm	FYE	31-Dec	$101.9	-2.4%	($58.4)	20.3%	($60.5)	20.3%
Luminex	Q4	31-Dec	$78.2	8.2%	$9.1	NM	($3.0)	11.8%
Luminex	FYE	31-Dec	$306.6	13.3%	$37.2	77.0%	$29.4	113.0%
Mettler-Toledo International	Q4	31-Dec	$778.0	9.6%	$193.9	7.0%	$149.0	8.1%
Mettler-Toledo International	FYE	31-Dec	$2,725.1	8.6%	$574.2	13.9%	$448.0	16.5%
MKS Instruments	Q4	31-Dec	$512.0	26.4%	$119.8	92.1%	$77.6	70.5%
MKS Instruments	FYE	31-Dec	$1,916.0	48.0%	$406.2	159.2%	$339.1	223.6%
Pacific Biosciences	Q4	31-Dec	$24.9	-3.1%	($20.5)	-14.9%	($20.8)	-9.1%
Pacific Biosciences	FYE	31-Dec	$93.5	3.1%	($89.8)	-26.1%	($92.2)	-23.9%
QIAGEN	Q4	31-Dec	$369.9	0.9%	$43.4	933.3%	($39.7)	NM
QIAGEN	FYE	31-Dec	$1,417.5	5.9%	$153.4	55.3%	$40.4	-49.8%
Teledyne Technologies (Instrumentation)	Q4	1-Jan	$254.8	13.4%	$31.4	4.0%	NA	NA
Teledyne Technologies (Instrumentation)	FYE	1-Jan	$953.9	8.8%	$127.4	16.0%	NA	NA
Other Currencies								
Biotage	Q4	31-Dec	SEK 188.9	5.5%	SEK 32.3	34.0%	SEK 34.6	97.7%
Biotage	FYE	31-Dec	SEK 748.1	12.0%	SEK 133.6	34.8%	SEK 138.7	49.5%
JEOL	9 Mo.	31-Dec	¥67,817	3.2%	¥489	NM	¥898.0	NM
JEOL (Sci. & Meas. Inst.)	9 Mo.	31-Dec	¥44,834	4.3%	-¥693	44.1%	NA	NA
Shimadzu	9 Mo.	31-Dec	¥263,327	11.4%	¥25,437	15.9%	¥18,094	14.0%
Shimadzu (Analy. & Meas. Instr.)	9 Mo.	31-Dec	¥160,881	11.4%	¥22,940	10.6%	NA	NA

NA = not available, NM = not material