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Instrument Business Outlook

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Company Capabilities and New Products on Display at SLAS 2019

This year's Society for Laboratory Automation and Screening (SLAS) meeting was held February 2–6 in Washington, DC, as part of the conference's bicoastal schedule. According to organizers, attendance totaled 5,126, the highest in its history in DC. The number of companies exhibiting increased 4.0% from last year's event held in San Diego, California (see ***IBO*** 2/15/18) to 311 companies, and was a 5.9% increase from the last time the show was held in DC (see ***IBO*** 2/15/17). Next year's conference will be held January 25–29 in San Diego.

Bio-Rad Laboratories

At the conference, Bio-Rad Laboratories announced the introduction of an API for its ZE5 flow cytometer. The API allows the device to interact directly with an ecosystem of liquid handlers and other components, allowing use in high-throughput screening applications. The API is now available and offered as an upgrade for current as well as newly sold systems.

Corning

Corning highlighted its 3D cell culture solutions and its offerings designed to make automation easier. The company told ***IBO*** that 3D solutions offer the ability to find lead compounds that cannot be found using a 2D approach.

The Corning products on display included the 1536-well microplates for growing spheroid cell cultures, which feature the company's Ultra-Low Attachment for cell suspension. Developed for 3D high-throughput screening, the microplate was introduced last summer and addresses the substantial interest in 3D screening for drug discovery and development, according to the company.

Gilson

Gilson announced the launch of its line of connected pipettes, the Trackman Connected, enabled through its PipettePilot app and related accessories. The system allows users to plan and execute their pipette plans more efficiently and robustly through the use of a visual guide and automated pipette controls. The plate plans are then stored and tracked through the app for full documentation. The system also includes an environmental sensor to document the conditions during the run, including temperature, humidity and pressure.

In addition to the Trackman Connected launch, Gilson also featured at the show advances in its SciNote ELN (which they are co-marketing with BioSistemika). The two major improvements included the automatic transfer of the pipetting data from the Trackman Connected system into the ELN, as well as an AI component to help users document and write Materials and Methods sections of papers from experiments documented in the platform.

Lonza

Lonza's technologies for pharmaceutical research include nucleofection, which it calls the technology of choice for non-viral delivery. The company sells both nucleofector kits and instrumentation. On display at the show was the 4D Nucleofector LV Unit, the company's largest-volume closed system for transfection, which can be used with up to two billion cells for applications such as research of CAR-T and gene therapies.

The company also exhibited its automated endotoxin testing platform, the PyroTec PRO, a plate-based robotic system for endotoxin detection, with WinKQCL 6.0 software for automated template creation. Applications include endotoxin testing of medical devices. The system incorporates Lonza's chromogenic tests for bacteria endotoxin testing, with plans to introduce pyrogene testing in the near future.

Nanotemper

"Scientists should be able to focus on their work, not learn how to use the tools." The founders of Nanotemper, who are scientists themselves, had this as their mission and vision when designing their newest instrument, the Dianthus protein characterization system, for efficient drug discovery screening. The Dianthus is capable of screening 10,000 compounds per day and an output of 384 data points in 30 minutes. According to the company, the Dianthus provides the lowest price per data point due to low sample volume requirements, reduction in assay development time, no down time, no maintenance and data analysis software. While pricing is variable, there are three different

packages available.

With long shelf lives, Nanotemper's 384-well proprietary plates can be sealed, enabling use of the same plate (though not the same wells) for different experiments, allowing for a flexible throughput and savings in plate cost. The Dianthus is fully automated and can be integrated into any part of the workflow. The data analysis capabilities are comprised of an intuitive control software, as well as the screening software in which you can accurately measure the K_D values and get raw data.

While Nanotemper also offers other systems that conduct protein stability measurements, the company hopes to use the Dianthus as a way to move affinity binding measurements from academia to the pharmaceutical industry. The company told ***IBO*** that it approaches problems in a different way, one that challenges the "gold standard," by regarding its instruments as a cohesive workflow and not the last checkpoint.

NanoView Biosciences

NanoView Biosciences launched its first platform, the ExoView System, at SLAS 2019. The system is designed to collect and characterize exosomes, small extracellular particles known to play a role in a wide variety of biological processes. Collection and characterization of exosomes has been challenging in the past because of their small size and inability to be imaged directly. The ExoView uses a proprietary interferometric imaging technology along with fluorescence imaging to view and characterize the surfaces or payloads of the exosomes directly. The device is shipping and available for $99,500.

PerkinElmer

PerkinElmer exhibited a wide range of instrumentation and consumables at SLAS this year, emphasizing the ability to easily couple each to provide labs with a total solution and scalability. As the company told ***IBO***, PerkinElmer differentiates itself by being a full solution provider. The company also stated that its goal is to position itself as a provider for both centralized and decentralized diagnostics, as decentralized diagnostics become increasingly important and require smaller volumes.

At its booth, the company exhibited a number of different systems that can be combined into an automated workflow. They included the chemagic Prime workstation for DNA and RNA extraction and liquid processing of 96 samples at a time. The Prime is available for $130,000–$140,000 with the ability to bundle with other PerkinElmer products, such as reagents and plates.

Designed for users with lower-throughput needs, such as decentralized service labs, the chemagic Prime Junior for extraction and liquid handling processes up to 48 samples at a time. The instrument also performs eluate handling and has reserved deck space for automated PCR NGS, or general assay setup. Currently available for RUO applications, the system is in the process of gaining CE-IVD approval.

Also available is the chemagic 360, released two years ago, for nucleic acid extraction; the LabChip GX Touch for measuring the concentration of DNA in a sample; and the JANUS liquid handler for sample preparation for sequencing and PCR.

Synchron and Festo

Lab automation firm Synchron partnered with technology manufacturer Festo at SLAS 2019 to showcase their DNA Cruiser, an ultra-high throughput DNA extraction instrument. Capable of conducting up to 38,400 extractions in one day, the company recently completed its first installation for Enza Zaden, a vegetable seed company, and is on their second installation. Set up for processing in a series instead of in parallel, the cruiser is fully automated and comprised of six "function stations." The carriers bring the plates from function to function, which allows for high volumes of DNA to be extracted more efficiently. As a result, the system increases lab safety by reducing the time scientists must interact with potentially dangerous chemicals.

Installation time varies depending on the customer's need, as Synchron and Festo's partnership provides custom product and services. Installation can take from half a day to several days without disrupting processes in progress. A Festo representative is always be available to aid with installation and engineering services under the partnership. The companies hope to move the system into the microbiology and life science markets for applications, such as automating the inoculation of petri dishes and automating ELISAs.

Tecan

Tecan launched the Tecan NGS DreamPrep system, an automated solution for NGS library preparation, leveraging its Fluent liquid handling automation platform and Infinite plate-reader technology as well as their newly acquired NuGEN Technologies reagents (see ***IBO*** 8/31/18) to provide a complete solution for library preparation and online sample QC. The complete solution delivers prepared and QC'd libraries from genomic DNA ready for downstream sequencing on Illumina platforms.

New Funding Announcements

NHS England Gets Large Funding Increase

Amount: £20 billion ($25.7 billion at £0.78 = $1)

Recipient: National Health Service (NHS) England

Funder: Government of England

Date Announced: January

A new 10-year plan has been announced by the British government aimed at developing methods for prevention and early detection of diseases. The plan will provide NHS England with an additional £20 billion ($25.7 billion) divided over a five-year period ending in 2023–24, accounting for a 3.4% increase year over year.

Of the total funding, £2.3 billion ($3.0 billion) will be directed towards mental health research, while general practitioners and community care will receive £4.5 billion ($5.8 billion) over 5 years. The onset of Brexit has left the NHS' workforce in a precarious situation, as staff shortages are expected to occur. To tackle this issue, the new funding will help NHS England train between 25% and 50% more nurses.

Australia's Parkinson Mission Gets Boost From Government

Amount: AUD 30 million ($21.3 million at AUD 1.41 = $1) over 5 years

Recipient: Australian Parkinson's Mission

Funder: Australian government

Date Announced: January

The Australian government is providing AUD 30 million ($21.3 million) to the Australian Parkinson's Mission for funding clinical trials of medications that have been shown to have potential to slow down or completely stop the progression of Parkinson's disease. The Mission is a partnership between Parkinson's Australia, the Garvan Institute of Medical Research, Garvan Research Foundation, The Cure Parkinson's Trust (UK), Shake It Up Australia Foundation and the Michael J. Fox Foundation.

The research will include genomic sequencing analysis combined with drug trials to help scientists understand the fundamental causes of the disease. By identifying biomarkers, researchers will be able to measure successful treatments as well as monitor the progression of Parkinson's to help accelerate earlier diagnoses and interventions.

Germany to Establish Research Facility for Accelerating Domestic Battery Cell Production

Amount: €500 million ($568 million at €0.88 = $1)

Recipient: Various

Funder: German government

Date Announced: January

The German government announced in January plans to establish a new research facility for domestic companies to learn how to develop battery cells for electric vehicles. The initiative is to ensure that manufacturers are not dependent on Asian suppliers for the technology and to increase production in Germany, thus improving the economy. The government is aiming to protect German carmakers as automotive technology continues to evolve away from the use of combustion engines. The facility will transfer research from Germany's Fraunhofer science institute to private companies in order to lessen the risk for companies that want to begin manufacturing electric vehicle batteries.

Companies such as BMZ, Liacon Batteries, Customcells, EAS Batteries and TerraE will play an important role in establishing the facility. The government will announce the location of the research facility by mid-2019.

US DoE Zeroes In on Plant and Microbe Research

Amount: $66 million

Recipient: Various

Funder: US Department of Energy (DoE)

Date Announced: February

The US DoE is providing universities, industry and nonprofit research institutions, as well as collaborators at DoE national labs and other federal agencies, $66 million over the next three years for new genomics-based research on plants and microbes. Funding will be split between plant research and microbe research, with $30 million and $36 million, respectively, set aside for the initiatives.

The plant initiative will concentrate on researching the gene function in plants grown for bioenergy and bioproducts by identifying the relationship between particular regions of plant genomes, and certain plant behaviors and qualities. Researching the basis of how microbial communities cycle nutrients in the soil and the environment will be the focus of the microbe initiative, with researchers aiming to better understand the significant role microbes play in shaping the planet's environment. The funding is projected to be in the form of three-year grants, beginning in fiscal 2019.

UK Interdisciplinary Research Hubs to Tackle Global Challenges with New Funding

Amount: £200 million ($257.7 million)

Recipient: Interdisciplinary Research Hubs

Funder: UK Research and Innovation (UKRI)

Date Announced: January

The UKRI is taking on the planet's most significant challenges through a £200 million ($257.7 million) investment in a worldwide collaboration project. The initiative will be led by 12 Interdisciplinary Research Hubs, which provide a framework to the UK's Global Challenges Research Fund and tackle challenges that are affecting disadvantaged populations and help position the UK as a leader of R&D. These Hubs will partner with governments, international agencies and NGOs in 85 countries to make the world more sustainable and prosperous.

Challenges such as improving human health, strengthening ecological systems and biodiversity in oceans and on land, establishing sustainable agricultural practices and developing systems of resilience in the face of natural disasters are among the goals the Hubs aim to achieve.

VWR Parent Avantor Files for IPO

Washington, DC 2/8/19; Radnor, PA 2/8/19—Avantor, a provider of materials and consumables, equipment, and services and specialty procurement to the biopharmaceutical, health care, education and government, and advanced technologies and applied materials industries, has filed for an IPO. In 2017, company sales grew 80.4% to $1,247.4 million (see Bottom Line). Nine-month 2018 revenues grew 748.1% to $4,390.4 million, with VWR accounting for 79% of revenues. The company acquired lab equipment distributor VWR in November 2017 (see ***IBO*** 11/30/17). Nine-month adjusted net loss rose from $19.9 million to $33.6 million. Biopharma accounted for 49% of sales for the period, part of a total 65% sales from life sciences. Recurring revenue made up 85% of sales, including 33% of revenues being from proprietary materials and consumables.

Renaissance Capital estimates the IPO will raise $1.5 billion. As of September 30, 2018, Avantor had $7.2 billion in debt. Avantor, controlled by private equity firm New Mountain Capital, refinanced its debt when it acquired VWR, another New Mountain Capital company. Besides lab distributor and aftermarket supplier VWR, the company also owns the J.T. Baker lab chemicals business. VWR was a public company before it was acquired by Avantor.

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bioMérieux Buys Food Testing Firm

Marcy l'Étoile, France 2/7/19— Diagnostics firm bioMérieux has purchased molecular testing firm Invisible Sentinel for $75 million in cash. Invisible Sentinel 2018 sales grew double digits to $9 million. Invisible Sentinel's Veriflow technology is used to detect pathogens and spoilage organisms in food and beverage. More than one million Veriflow tests have been sold since 2014. bioMérieux stated that the technology complements its GENE-UP products for molecular food testing, as Veriflow tests can run on the same system, and allows bioMérieux to enter new market segments such as breweries and wineries. "This acquisition illustrates bioMérieux's commitment to bring innovative solutions to customers of all sizes to ensure food and beverage quality and contribute to protecting consumer's health," commented Nicolas Cartier, executive vice president, bioMérieux's Industrial Microbiology Unit.

Based in Philadelphia, Pennsylvania, Invisible Sentinel has 40 employees. The company's Veriflow technology improves upon traditional PCR food testing, according to its website, with easier sample preparation, greater ease of use, rapid turnaround and low cost. For instance, the DNA Signature Capturing Technology eliminates the need for enrichment. The company sells tests for food protection, and beer, wine and water quality as well as a dedicated thermocycler and reader. bioMérieux's GENE-UP is a real-time PCR technology.

Mining Lab Automation Specialist Purchased

Copenhagen, Denmark 2/11/19—FLSmith has acquired IMP Automation, a provider of automated solutions for mining labs with a strong presence in Australia and South Africa. IMP Automation has more than 130 employees and annual revenues of DKK 250 million ($39.6 million at DKK 6.32 = $1). "Knowing your ore characteristics from the mine and all the way through the processing plant is of increasing importance in mining, as declining ore grades make it necessary to increase productivity by process optimization," stated Manfred Schaffer, president of Mining at FLSmidth. "We see a strong match between some of our digital initiatives in FLSmidth and IMP's automation solutions that will help miners get better data on their ore and assist in optimizing the processing. With this acquisition, our flowsheet of laboratory solutions within mining and minerals processing is complete, and this will be of great value to our customers." The transaction is expected to close in the second quarter.

IMP Automation provides integrated and customized automated solutions, as well as distributes a wide variety of lab instrumentation, such as materials testing equipment, microscopes and atomic spectroscopy systems, and associated aftermarket items. In addition to industrial labs, the company also serves life science labs.

Scientific Digital Imaging Makes Purchase

London, UK 2/4/19; Leicester, UK 2/4/19—Scientific Digital Imaging (SDI), which designs and manufactures scientific and technology products, has acquired Thermal Exchange for £847,037 ($1.1 million at £0.76 = $1) and an additional payment at completion. Thermal Exchange provides processing cooling and temperature control systems for industrial, medical and scientific applications and has 15 employees. Annual revenues for the company for the year ending September 30, 2018, totaled £1.4 million ($1.8 million), with a gross profit of £0.95 million ($1.3 million) and profit before tax of £0.21 million ($0.27 million). "Thermal Exchange represents another step in our Group growth strategy and is a complementary fit providing potential areas for growth alongside a talented workforce," stated SDI Chairman Ken Ford. "The acquisition is in line with our previously announced strategy of organic and acquisitive growth and is expected to be earnings enhancing in its first full year of ownership." The UK accounts for

86% of Thermal Exchange's sales.

*For the lab, the company provides circulation chillers, as well as cooling systems for lasers and microscopy, supplying customers both directly and as an OEM partner for other companies. SDI expected synergies its Applied Thermal Control business, which supplies recirculating chillers, which SDI acquired in 2017 (see **IBO** 9/15/17).*

Fourth Quarter 2018 Results: Bio-Techne, Hitachi High-Technologies, HORIBA, Illumina, QIAGEN

Bio-Techne Maintains Double-Digit Growth

Bio-Techne fiscal second quarter revenues grew double digits, led by Protein Sciences sales, which rose double digits organically (see Bottom Line). This marks the first time that Bio-Techne's organic revenue increased in the double digits sequentially. Despite a decrease in basis points, adjusted operating margin increased 260 basis points, excluding the impact of the acquisition of ExosomeDX (see **IBO** 06/30/18). This increase was driven by strong volume leverage, diverse product sales and solid productivity.

Bio-Techne Q2 FY19						
	Rev. (M)	Chg.	Acq./Div.	Currency	Organic Chg.	% of Rev.
Total	$174.5	13.2%	3%	1%	11.0%	
Protein Sciences	$135.5	15.6%	3%	1%	14.0%	78%
Diagnostics and Genomics	$39.3	5.9%	4%	—	2.0%	22%
Intersegment	-$0.2	186.7%	—	—	—	—

Click to enlarge

Geographically, Greater China led the way with a reported 30% organic sales increase. This is the first time Greater China experienced over 30% organic growth for two consecutive quarters. One reason for the region's revenue growth includes PrimeGene's offerings in cell therapy for hospitals, which accounted for approximately 30% of Chinese sales. In addition, instruments and RUO sales in Greater China increased approximately 50% and 25%, respectively. US sales grew organically in the low teens, while Europe and Japan were the only regions to have less than double-digit revenue growth. Despite Japan's less than stellar sales growth, APAC, excluding China, grew organically in the mid-teens, thanks to strong sales in South Korea and India.

Bio-Techne Q2 FY19		
	Adj. Op. Margin	Chg. (bps)
Total	33.2%	-322
Protein Sciences	43.5%	65
Diagnostics and Genomics	-2.7%	-1856

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Protein Sciences' experienced revenue growth across all major product categories, with most product lines experiencing double-digit sales growth. Highlights included a 30% sales increase for Western blot instruments, 20% sales increase for Biologics iCE and 50% sales increase for Ella. Another highlight was double-digit sales growth for the entire assay product line. Protein Sciences also benefitted from consistent sales of core reagents, especially antibodies and cell and gene therapy products, which grew more than 20%. Excluding lower-margin acquisitions, Protein Sciences' adjusted operating margin increased 43.5%, a 60-basis point change. The company credited strong

volume leverage and operational productivity, which helped offset the lower-margin acquisitions.

Diagnostics and Genomics revenue grew modestly, despite delivering solid sales for both RUO and diagnostics product lines. Other highlights include a low-single digit increase for the ACD product line.

A factor influencing the modest growth was a tough year-over-year comparison. Regarding adjusted operating margin performance, excluding the dilution from Exosome Diagnostics acquisition, Diagnostics and Genomics' operating margin grew 17.7%, or 180 basis points, thanks to profitable, diverse product sales.

Bio-Techne Q2 FY19			
	Rev.	Chg.	% of Rev.
US	$92.9	15.3%	53%
EMEA, excl. UK	$38.4	5.7%	22%
UK	$8.8	7.9%	5%
APAC, excl. Greater China	$13.4	13.3%	8%
Greater China	$16.3	23.7%	9%
Rest of World	$4.6	16.1%	3%

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End-market wise, biopharma sales grew approximately 10%, while academic sales rose in the mid-single digits. Bio-Techne did not give a financial forecast for fiscal third quarter 2019.

Clinical Analyzers Sales High for Hitachi High-Technologies' Science & Medical Systems Segment

Third quarter fiscal 2019 revenues increased, thanks to Hitachi High-Technologies' three main business segments (Science & Medical Systems, Electronic Device Systems and Industrial Systems) experiencing double-digit increases. Despite decreased sales for its scientific instruments and biotechnology products, the Science & Medical Systems segment sales offset those losses due to the high sales of clinical analyzers in the Asian market.

Hitachi High-Technologies Science & Medical Systems Q3 FY19			
	Rev. (M)	Chg.	% of Rev.
Total	¥480	13.5%	
Medical Products	¥297	28.0%	62%
Scientific Instruments	¥75	-3.8%	16%
Electron Microscopes	¥74	8.8%	15%
Biotechnology Products & Other	¥34	-24.4%	7%

Click to enlarge

The company forecasts year-end fiscal 2019 division sales to increase 9% to ¥7,500 billion ($66.5 billion = ¥112.76 = $1).

Hitachi High-Technologies Q3 FY19			
	Rev. (M)	Chg.	% of Rev.
Total	¥1,796	11.2%	
Advanced Industrial Products	¥791	5.3%	44%
Science & Medical Systems	¥481	13.4%	27%
Electronic Device Systems	¥333	18.5%	19%
Industrial Systems	¥191	20.1%	11%

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Europe a Steady, Consistent Region for HORIBA

Q4 2018

HORIBA's combined revenues for its Scientific (SI), and Process & Environmental Instruments and Systems (P&E) businesses rose 2.4% in the fourth quarter 2018 to ¥14,071 ($124.8 million at 112.76 = $1) to make up 22% of total company sales (see Bottom Line).

HORIBA Q4 FY18			
	Rev. (M)	Chg.	% of Rev.
Process & Environmental Instruments & Systems	¥5,861.0	8.6%	13%
Scientific Instruments & Systems	¥8,210.0	-1.6%	18%

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Geographically, SI sales in Europe grew the fastest, up 12.1% to ¥1,738 ($15.4 million). Sales in Japan advanced in the high single digits, rising 5.8% to ¥2,102 ($18.6 million). Sales for the regions accounted for 19% and 24% of segment revenue, respectively. In Asia, sales advanced in the lower single digits, only rising 2.9% to ¥2,444 ($21.7 million), though the region accounted for 29% of segment revenue. The Americas was the only region that had a sales decrease, down 20.8%.

HORIBA Q4 FY18				
	SI		PE	
	Rev. (M)	Chg.	Rev. (M)	Chg.
Japan	¥2,102	5.8%	¥2,755	13.2%
Asia	¥2,444	2.9%	¥1,426	-10.4%
Americas	¥1,928	-20.8%	¥762	23.9%
Europe	¥1,738	12.1%	¥918	21.1%

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Geographically, P&E sales in the Americas, Europe and Japan advanced in the double digits, rising 23.9%, 21.1%, 13.2%, and respectively. Sales in the Americas, Europe and Japan accounted for 13%, 16% and 47% of segment revenue. P&E sales in Japan declined 10.4% to ¥1,426 ($12.6 million).

FY 2018

HORIBA's combined revenues for its SI and P&E businesses rose 8.2% for the year to ¥47,115 million ($417.8 million at 112.76 = $1), comprising 22% of total company sales (see Bottom Line).

HORIBA FYE 18			
	Rev. (M)	Chg.	% of Rev.
Process & Environmental Instruments & Systems	¥19,361.0	11.1%	42%
Scientific Instruments & Systems	¥27,754.0	6.3%	60%

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P&E sales were driven by the Americas and Asia. In the case of Asia, the increase in sales was attributed to high demand for water quality and air pollution analyzers, while in the Americas, process measurement equipment drove regional sales. Operating income increased 85.3% to ¥2,027 million ($18.0 million) due to increased sales in Asia. P&E fiscal first-half revenue is forecast to rise 8.1% to ¥10,000 million ($88.7 million) and the full-year sales forecast is expected to rise 3.3% to ¥20,000 million ($177.4 million).

HORIBA FYE 18				
	SI		PE	
	Rev. (M)	Chg.	Rev. (M)	Chg.
Japan	¥7,275	12.4%	¥9,538	1.6%
Asia	¥7,609	4.1%	¥4,616	21.7%
Americas	¥7,117	-1.8%	¥2,677	30.1%
Europe	¥5,753	13.1%	¥2,528	15.2%

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Full-year 2018 SI sales in Europe and Japan advanced in the double digits, while Asian sales rose in the mid-single digits. The increase in segment revenue was attributed to high R&D spending. SI sales in the Americas experienced a slight loss with a 1.8% decline, attributed to HORIBA's continued investment to establish an industrial presence in the region. As a result of that investment, the operating income for SI decreased 55.6% to ¥221 million ($2.0 million). SI fiscal first-half revenue is forecast to rise 3.7% to ¥13,000 million ($115.3 million) and the full-year forecast anticipate a 27.9% decline to ¥20,000 million ($266.1 million).

Illumina Finishes Strong with Record Sales

Q4 2018

Illumina Q4 FY18			
	Chg.	Rev. (M)	% of Rev.
Consumables	9.3%	$562	65%
Instrument	22.3%	$170	20%
Other Products	0.0%	$6	1%
Service & Other	8.4%	$129	15%

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Illumina fourth quarter 2018 revenues grew 11.4% and were led by 12% growth in sequencing and 7% growth in microarray sales, respectively (see ***IBO*** *01/31/19*).

Illumina Q4 FY18		
	Rev. Chg.	% of Rev.
US	12.0%	56%
Europe	12.4%	27%
Greater China	8.5%	9%
Asia Pacific	9.4%	8%

Click to enlarge

Sequencing consumable sales grew 16% when adjusting for the timing of a $5 million China tariff-related stocking order for the fourth quarter. Mid-throughput sequencing consumables had a record quarter due to the high sales of NextSeq consumables. The highlight for low-throughput sequencing consumables was the strong demand for both MiSeq and MiniSeq, as well as respectable sales from iSeq consumables.

Illumina Q4 FY18			
Adj. Op. Profit (M)	Chg.	Adj. Op. Margin	Chg. (bps)
$211	-13.5%	24.3%	-702.57

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Sequencing systems sales reached a quarterly revenue record of $159 million, making it the strongest quarter for the product line due to an overall strong sales portfolio, with more than 100 NovaSeq shipments. In addition, NextSeq systems sales set a company record of being the second highest system shipped since a product launch.

Sequencing services sales increased 19.5% to $104 million, led by strong sales to Genomics England. Sequentially, revenue was down $5 million due to oncology collaboration payments that did not repeat in the fourth quarter. In total, combined sequencing revenue grew 12%.

Illumina Q4 FY18		
	Rev. Chg. Sequencing	Rev. Chg. Microarrays
Consumables	7.9%	17%
Instrument	21.4%	37.5%
Other Products	20.0%	NM
Service & Other	19.5%	-21.9%

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Microarray consumables sales increased 17.1% to 13 million, while microarray services sales declined 21.9%. Microarray systems sales were up $3 million, but declined $5 million sequentially. Combined microarrays revenue increased 7% to $132 million.

Geographically, sales in the US and Europe experienced double-digit growth, while Greater China and APJ (Asia Pacific Japan) revenues increased in the high single digits. Specifically, Greater China grew 28% when adjusting for the effects of tariff-related stock orders in the second and third quarters of 2018. Sequentially, APJ experienced a 21% sales increase.

Illumina expects first quarter total revenues to be down sequentially due to a $50 million sales decline for sequencing systems. This has been a trend for the company for the past four years; however, Illumina expects a year-over-year $466 million sales forecast for sequencing consumables to offset the loss. Sequencing services and other revenues are expected to be flat due to anticipated sales declines for Genomics England, while microarrays sales are forecast to be in the mid- to high-single digits.

FY 2018

Illumina FYE 18			
	Chg.	Rev. (M)	% of Rev.
Consumables	23.0%	$2,156	65%
Instrument	10.5%	$569	17%
Other Products	14.3%	$6	1%
Service & Other	26.1%	$584	15%

Click to enlarge

Illumina full-year 2018 revenues grew 21.1% and were led by growth in sequencing and microarray sales, respectively (see ***IBO*** *01/31/19*).

Illumina FYE 18		
	Rev. Chg.	% of Rev.
US	17.6%	56%
Europe	30.3%	26%
Greater China	25.0%	11%
Asia Pacific	14.0%	8%

Click to enlarge

Sequencing consumables revenue grew 23% thanks to strong sales growth across high-throughput, mid-throughput and low-throughput categories. The high-throughput sequencer HiSeq continued its sales decline as customer demand for NovaSeq increased dramatically.

Illumina FYE 18			
Adj. Op. Profit (M)	Chg.	Adj. Op. Margin	Chg. (bps)
$928	35.1%	27.8%	287.91

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For the year, sequencing systems sales rose, thanks to 600 NovaSeq systems being shipped, a 110% increase. HiSeq ended the year with approximately 350 units shipped in the first two quarters. The HiSeq upgrade cycle's strong demand resulted in the product representing 30% of sequencing systems orders. In total, combined sequencing systems increased 21% with strong sales growth across all research, translational and clinical products.

Illumina FYE 18		
	Rev. Chg. Sequencing	Rev. Chg. Microarrays
Consumables	23.0%	23%
Instrument	9.9%	19%
Other Products	10.5%	NM
Service & Other	29.2%	19%

Click to enlarge

Illumina declared its full-year 2019 revenue growth to be 13%–14%, or $3.77 billion–$3.8 billion, with expectations

of an 1% currency headwind. Additionally, the company expects sequencing revenue to grow in the mid-teens and sequencing consumables to grow above 20%. Microarrays revenue growth is anticipated to slow to the low single-digits due to the company's cautious view of the consumer market. Illumina anticipates sequencing systems sales to grow in mid-single digits, with NovaSeq shipments to be flat or slightly higher than 2018 shipments.

QIAGEN Fourth Quarter Sales Soft, But End the Year Strong

Q4 2018

QIAGEN reported soft fourth quarter 2018 sales growth (see Bottom Line). On a constant currency basis, sales growth was 5%, excluding the approximate three percentage-point currency headwind. QIAGEN missed its constant currency growth target of 6%–7% due to various changes, such as the divestment of the veterinary testing assay portfolio, which caused needed adjustments to a third-party R&D project, and the continuing reduction of third-party service contracts for QIAGEN instruments. All figures mentioned are in constant currency.

QIAGEN Q4 FY18				
	Rev. (M)	Chg.	Rev. Chg. Excl. Currency	% of Rev.
Total	$402.0	1.3%	5%	
Molecular Diagnostics	$194.0	0.5%	5%	48%
Academia	$95.0	3.3%	6%	24%
Pharma	$74.0	2.8%	5%	18%
Applied Testing	$39.0	-2.5%	1%	10%

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Instrument sales advanced 13%, but were partially offset by a 10% decline in service revenue. QIAsymphony experienced high quarterly sales, with more than 120 new placements.

Consumables and related revenue sales were stable, thanks to solid sales across the Molecular Diagnostics, Pharma and Academia customer segments. However, the Applied Testing customer segment only experienced mid-single-digit revenue growth. Revenue growth for consumables increased 4%.

QIAGEN Q4 FY18				
	Rev. (M)	Chg.	Rev. Chg. Excl. Currency	% of Rev.
Consumables and Related Rev.	$344.0	1.2%	4%	85%
Instruments	$59.0	3.5%	5%	15%

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Molecular Diagnostics sales advanced 5% to $194 million, excluding the approximate four percentage-point headwinds from low US HPV sales and the discontinuation of instrument service contracts. Strong sales growth was attributed to double-digit sales for QuantiFERON-TB. Sales were partially offset, however, by a decline in instrument service revenue.

As a whole, the following Life Science customer segments rose 5% on a combined basis: Academia posted the fastest sales growth among the company's main four customer segments, with a 6% increase to $95 million. Strong sales growth was credited to the double-digit sales growth in instruments and single-digit revenue growth in consumables. Japan was a strong performer among the regions.

QIAGEN Q4 FY18			
	Rev. Chg.	Rev. Chg. Excl. Currency	% of Rev.
Americas	-4.0%	-4%	42%
Europe/Middle East/Africa	6.7%	13%	35%
Asia-Pacific/Japan	5.8%	8%	23%

Click to enlarge

Applied Test sales continued to be impacted by the divestment of veterinary testing assays, which resulted in only a 1% increase to $39 million.

Pharma sales rose 5% to $74 million, which was slightly below QIAGEN's sales target. This was due to a combination of low-single-digit growth in consumables and double-digit growth in instruments.

QIAGEN Q4 FY18			
Adj. Op. Profit ($M)	Chg.	Adj. Op. Margin	Chg. (bps)
$119	-1.9%	29.7%	-95

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Geographically, Europe/Middle East/Africa was the best performing region with 13% growth to $143 million. Revenue in France, Italy, Belgium and Turkey grew, while Germany's sales slackened.

Asia Pacific sales grew 8% to $91 million. This was due to the double-digit growth in Japan, as well as South Korea recovering from the impact of the 2017 tenders for QuantiFERON -TB.

The Americas were the worst performing region, with sales declining 4% to $91 million. An instrument service revenue decline in the Molecular Diagnostics customer segment was largely due to Americas' overall revenue slump.

FY 2018

Full-year 2018 QIAGEN revenue advanced 5.8%, reaching its full-year revenue growth forecast of 6%–7% (see Bottom Line), due to reaching various product sales targets throughout the year. For example, QuantiFERON-TB sales grew 21% to $223 million, and QIAGEN's NGS portfolio surpassed its 2018 sales target, advancing to $140 million, a 21% increase. Organically, sales grew 6.7%, excluding business portfolio changes and acquisition contributions. All figures mentioned are in constant currency.

QIAGEN FYE 18				
	Rev. (M)	Chg.	Rev. Chg. Excl. Currency	% of Rev.
Total	$1,502.0	5.8%	5%	
Molecular Diagnostics	$732.0	7.2%	8%	49%
Academia	$342.0	5.9%	5%	23%
Pharma	$291.0	5.4%	5%	19%
Applied Testing	$137.0	0.0%	0%	9%

Click to enlarge

Instrument sales advanced 6% in large part to the company exceeding its placement target for the QIAsymphony at 2,300, and a broad NGS portfolio whose sales grew in the double digits. For 2019, QIAGEN expects 2,500 placements of QIAsymphony. Regarding the NGS portfolio, the company set a sales target of $190 million.

QIAGEN FYE 18				
	Rev. (M)	Chg.	Rev. Chg. Excl. Currency	% of Rev.
Consumables and Related Rev.	$1,315.0	5.6%	6%	88%
Instruments	$186.0	5.7%	6%	12%

Click to enlarge

Molecular Diagnostics posted the fastest sales growth among the company's main four customer segments. Strong sales growth was attributed to the 21% increase for QuantiFERON-TB revenue. With such high sales, QIAGEN set a 2020 sales forecast of $300 million for its QuantiFERON-TB tests.

The following Life Science customer segments grew 4% on a combined basis. Applied Test sales were mostly unchanged for the year, excluding the veterinary testing assay divestment. Both Pharma and Academia sales grew 5%.

QIAGEN FYE 18			
	Rev. Chg.	Rev. Chg. Excl. Currency	% of Rev.
Americas	5.8%	6%	46%
Europe/Middle East/Africa	5.8%	6%	33%
Asia-Pacific/Japan	5.4%	5%	21%

Click to enlarge

Despite having a disappointing fourth quarter 2018, the Americas performed the best geographically for the year advancing 6% to $693 million. Europe/Middle East/Africa sales grew 6% to $490 million, while Asia-Pacific sales advanced 5% to $315 million.

QIAGEN FYE 18			
Adj. Op. Profit ($M)	Chg.	Adj. Op. Margin	Chg. (bps)
$312	5.6%	20.8%	-4

Click to enlarge

For 2019, QIAGEN expects total company revenues to grow between 7%–8%, with a $30 million sales target for QIAstat-Dx. Currency effects are projected to add a 1% headwind to overall reported sales growth. Academia, Pharma and Applied Testing customer segments are each forecast to advance in the mid-single digits. As for the first quarter, the company expects revenues to grow 5%–6%. In terms of currency impact for the first quarter, the company expects a 4% headwind impact on revenue sales.

Handheld FTIR

Fourier-transform infrared spectroscopy (FTIR) is one of the most common analytical techniques utilized in laboratories today, finding use in nearly all industries and functions. All IR spectroscopy works on a principle of molecular absorption. First, IR light is passed through a sample. Molecules absorb this light at different, discrete energies, depending on the molecular structure. This energy causes molecular bonds to vibrate, with different molecular functional groups vibrating at different frequencies. Since light is absorbed at different frequencies, this information can be translated into an IR spectrum, which gives users useful information about the molecular makeup of the sample being analyzed. IR spectroscopy was first developed in the 1950s. A number of developments, such as the use of the Michelson interferometer and computers able to perform FT, allowed for the creation of FTIR with

improved speed and signal-to-noise ratio.

Many modern IR spectroscopy instruments utilize attenuated total reflection (ATR), allowing for little to no sample preparation. Using ATR, a beam of IR light passes through a crystal, which can be diamond, silicon or zinc-selenium. Within the crystal, the IR beam undergoes internal reflection that creates a wave of light that extends a few microns beyond the surface of the crystal. This light is absorbed by a sample placed on top of the crystal and is then interpreted to give an IR spectra. The development of ATR advanced FTIR even further, helping to create modern handheld FTIR instruments.

Handheld FTIR instruments are a relatively recent development, having been around for about a decade, and giving users more versatility in where and how to analyze samples. It opened the door to numerous applications that would be otherwise difficult or cumbersome for benchtop instruments. Functionally, handheld FTIR instruments are practically identical to their benchtop counterparts, but rely on smaller components, more rugged design and ease of use for a variety of environments.

Many of the applications for handheld FTIR instruments would be difficult to perform in a traditional lab setting. For example, one major application for these handheld instruments is to analyze metals, polymers and composites directly, which is useful in the aerospace and automotive industry. Combined with large spectral databases, handheld FTIR is used for security and safety purposes to quickly detect unknown narcotics, explosives and other chemicals. Industries where traditional benchtop FTIR instruments are used also employ handheld instruments. The pharmaceutical and chemical industries use these instruments to check raw materials, quickly analyze product intermediates during process development and to test finished products. Other applications well suited for the technology's field use are found in the metals and mining, agriculture and food, and paints and coatings industries.

There are a few vendors that produce handheld FTIR instruments, but Agilent Technologies, Smiths Detection and Thermo Fisher Scientific are the three largest. Smiths Detection and Thermo Fisher produce instruments like the HazMatID Elite and the Gemini Analyzer, respectively, which are each geared towards safety and security applications. Agilent, with its 4300 FTIR Analyzer, has been a leading vendor for handheld FTIR since its acquisition of A2 Technologies in 2011 (see ***IBO*** 1/31/11).

The total handheld FTIR market was just under $65 million in 2018. Growth is expected to be in the mid- to high single digits, driven by their use in growing pharmaceutical, aerospace and automotive, and government testing applications.

Handheld FTIR at a Glance:

Largest Markets

- Government
- Polymers
- Chemicals

Leading Suppliers

- Smiths Detection
- Thermo Fisher Scientific
- Agilent Technologies

Instrument Cost

- $50,000–$100,000

Correction: HORIBA and MANTA Instruments

In the January 31 issue of ***IBO***, in the Executive Briefing entitled "HORIBA Acquires Particle Characterization Technology," we incorrectly identified the measurement capabilities of MANTA Instruments' nanoparticle tracking

analyzer. The sentence should have read, “MANTA’s systems determine size distribution, number concentration, and the aggregation state of particles and aggregate size as small as 10 nanometers.” ***IBO*** regrets the error.

Government

The US FDA has announced plans to increase oversight of the supplements industry, targeting unlisted ingredients as well as disingenuous or deceptive health claims. The Administration has outlined the 12 warning and 5 advisory letters that it sent out earlier this month to companies suspected of selling formulations with unapproved drugs, or making unsubstantiated, illegal claims for treating diseases such as Alzheimer’s. With possible policy changes coming to the forefront, the oversight may lead to the greatest regulatory modernization since the inception of the policy, the Dietary Supplement Health and Education Act, enacted in 1994. While the FDA is not required to approve such products before their commercialization, the Administration has tasked the FDA with purging unsafe supplements from the market.

Supplement companies are able to avoid premarket approval and testing methods that are required for drugs, as the industry is regulated as food. Since the law was established in 1994, the industry has skyrocketed over 1,000%, growing from 4,000 products and $4 billion in annual sales to 80,000 products and $50 billion in annual sales.

Seventy-five percent of Americans regularly take dietary supplements, including 80% of the elderly population and 33% of children. In a 2015 study featured in the *New England Journal of Medicine*, approximately 23,000 emergency hospital visits in the US were due to consuming dietary supplements, with numerous visits related to cardiovascular issues tied to the use of weight loss or energy supplements.

Source: *The Washington Post*

Pharmaceuticals

The US and emerging markets will drive growth in the global pharmaceutical market, which is expected to surpass $1.5 trillion by 2023, growing at a CAGR of 3%–6% over the next five years. The US and emerging markets are forecast to have a CAGR of 4%–7% and 5%–8%, respectively. In 2018, global pharmaceutical spending hit $1.2 trillion.

The rise in spending in the US is largely attributed to an uptake in new products and brand pricing, but is simultaneously offset by expiring patents and generics. Chinese spending on pharmaceuticals is also continuing to rise, but despite expected to total $140–$170 billion by 2023, growth is expected to slow down to 3%–6%. Europe is expected to experience an even slower increase of 1%–4%, due to cost-containment policies and decreasing sales growth of new products. Japanese pharmaceutical market growth is projected to decline 3% each year through 2023 to result in 0% growth, in part due to exchange rates and uptake of generics.

In developed markets, new products and exclusivity losses will continue these trends, and product mix will keep steering towards specialty and orphan products. Over the next 5 years, 54 new active substance launches per year are forecast on average, with 67% of launches being specialty projects, which will increase specialty drugs’ share of spending to almost 50% by 2023. However, the impact of exclusivity losses is likely to reach $121 billion over the next five years, with the US taking most of the hit at $95 billion, or 80%.

While the cost of traditional drugs is slowing, oncology, orphan drug and specialty medicines’ prices are continuing to grow rapidly. This is mostly an effect of new drugs being used to treat smaller, more specialized populations, resulting in higher prices. Thirty percent and 45% of novel active substances over the next five years are expected to be for oncology and orphan drugs, respectively.

Source: *IQVIA*

Food

Agritech companies are increasingly embracing gene editing techniques, especially CRISPR, to not only fight fungal diseases, but also to ensure the production of safe crops with higher yields, as the United Nations. estimates that the world population will reach 9.8 billion by 2050.

Advocates are emphasizing the difference between gene editing, which uses existing genes as in the plant, and gene modification, in which foreign genes are transferred between crop species. Generally, genetically modified products can take up to 13 years to be brought to market and the process can cost up to $130 million; in contrast, genetically edited products take 5 years to be commercialized and cost up to $10 million.

A major hurdle in the popularization of gene edited products is consumer attitudes, with venture capital investors stating that “social license” is required from the public for gene edited crop companies to operate. Additionally, last July, the European Court of Justice ruled that gene edited crops are subject to the same requirements as genetically modified products, further increasing public skepticism of the trustworthiness of gene edited products. However, in the US, the USDA has so far indicated that gene editing is to be regulated in the same way as traditional breeding techniques, as long as there are little to no differences in outcomes.

Applications such as tomatoes with longer lasting flavor and non-browning mushrooms are already close to commercialization in the US. Other projects include low-gluten wheat and non-allergenic peanuts.

Source: *Financial Times*

India

India’s science funding has marginally increased as per the nation’s 2019–20 Union Budget, released earlier this month. The country’s Ministry of Science and Technology houses three departments—the Departments of Science and Technology, Biotechnology, and Scientific and Industrial Research. The Ministry’s overall budget expanded to total of INR 12,797.24 crore ($1.9 billion), to be shared among the three departments.

For the Department of Science and Technology, INR 5,321.01 crore ($799.82 million) was allotted, a 4.0% rise. The budget for the Innovation, Technology Development and Deployment program jumped 10.4% to INR 862.4 crore ($129.6 million), while funding for other scientific research within the Department grew 3.6% to INR 5,142.56 ($773.0 million). However, the general R&D budget for the Department decreased 2.5% to INR 481.0 crore ($72.3 million). The Department of Biotechnology’s budget increased 7.0% to INR 2580.34 ($387.9 million), with R&D for biotech totaling INR 1,475.0 crore ($221.7 million), growing 9.3%. Funding for the Industrial and Entrepreneurship Development project rose 9.8% to INR 1,755.2 crore ($263.8 million), and the budget for other scientific research in the Department of Biotechnology increased 7.0%, reaching INR 2,411.5 ($387.9 million).

Growing 7.1%, the 2019–20 budget for the Department of Scientific and Industrial Research totaled INR 4,895.9 ($735.9 million). Funding for industrial R&D surged 40% to INR 28.0 crore ($4.2 million), and the budget for the autonomous Council of Scientific and Industrial Research grew 6.9% to INR 4,831.6 crore ($726.3 million), with INR 4,531.6 crore ($681.2 million) allotted to national laboratories, growing 6.1%. The budget for other scientific research within the Department also expanded to INR 4,873.6 crore ($732.6 million), a 7.0% jump.

Source: *Ministry of Finance, Government of India*

Germany

Biotech companies in Germany raised a record level of capital in 2018, with over €1 billion ($1.1 billion) of venture capital and other equity investments driving the sector. After a period of volatility due to political developments at

the end of 2017 and start of 2018, German companies have a greatly improved outlook on the state of biotech in the country.

Private biotech companies drew €369 million ($420.1 million) in venture capital investments, a 54.4% spike, while public biotech companies raised €693 million ($789.0 million) through the stock exchange, resulting in a formidable increase of 96.9%. QIAGEN contributed the most to this figure, with the company issuing €445 million ($506.6 million) worth of convertible bonds. Equity inflows of German biotech companies almost doubled to reach €1.27 billion ($1.45 billion), an 88.4% jump.

According to a BIO Deutschland survey, 60% of companies have a favorable view of the current business climate, with 50% projecting even more promising conditions in 2019. Approximately 67% of survey respondents expect to expand their workforces this year, and 56% forecast increased R&D spending.

Source: *BIO Deutschland*

China

After a robust 2018, in which over $17 billion was invested in the sector, a 50% increase, the Chinese biotech industry is experiencing a cooldown of venture capital funding. In the past few years, China's biotech companies have made great progress, with over 800 new molecules currently in clinical trials or pre-trial testing phases, a massive 233% increase since 2012. Chinese companies have also greatly surpassed their US peers in areas such as CAR-T therapy, with more clinical trials taking place in China than in the US. Additionally, last April, the Hong Kong stock exchange started allowing listings of research-stage biotech companies that had not yet generated profits. The six Chinese companies that listed in 2018 raised HKD $25.4 billion ($3.2 billion); however, three companies ended up trading below their initial prices, leaving investors trying to match the high valuations before listing.

This led to an overall slowdown in investments in the biotech sector, which was also affected by the government's initiative to slow credit growth in order to reduce debt levels. The vast majority of investments in 2018 were made in the first six months of the year, and by the last quarter of 2018, Chinese venture capital investments in biotech were down 12%, with the number of deals falling 25% to 713.

New asset management regulations that necessitate a much more stringent matching of asset and liabilities maturities on startup capital from banks, trusts and listed companies greatly contributed to the cooling of investments. Chinese financial experts predict that 2019 will be the worst time to invest in biotech startups in the country, with funds requesting that companies accept lower valuations and cut operating costs.

Source: *Financial Times*

Life Science Instruments

Company Announcements

In December 2018, **Luminex** named Kenneth A. Samet to the Board, increasing the size of its Board to nine. He served as CEO of **MedStar Health**, a nonprofit health care delivery system.

Product Introductions

Syngene introduced in November 2018 the new generation G:BOX Chemi XX6/XX9 multi-application gel and blot systems for fluorescence and chemiluminescent imaging, which utilizes a wide-aperture f0.8 lens.

Labnet International released in January the ENDURO GDS II and GDS Touch II Gel Documentation Systems for visualization of DNA and protein stained within a gel. It features 3.2 MP image resolution.

In February, **BMG LABTECH** introduced the CLARIOstar Plus, featuring Enhanced Dynamic Range, which offers what it calls the largest possible detection dynamic range (8 decades) for ease of setup. Also new is the option to equip the reader with up to 3 dedicated detectors.

Gene-based Analysis

Company Announcements

In January, **NimaGen** agreed to licensing terms for research applications for a novel One Step PCR technology employing reverse complement probes from the **Salisbury NHS Foundation Trust**. Reverse Complement PCR (RC-PCR) permits the combined generation and flexible tagging of amplicon constructs from a target sequence or sequences in a single, closed tube amplification and indexing reaction.

Product Introductions

In December 2018, **Biolytic Lab Performance** launched the Dr. Oligo 192c, an affordable high-throughput oligo synthesizer. Built for operation in research and production facilities, the system synthesizes up to 192 high-quality oligos in one run.

Sales and Orders of Note

In January, **Bionano Genomics** announced that **Radboud University Medical Center** in Nijmegen, Netherlands, is among a growing number of global sites focused on human clinical applications that are adopting its Saphyr system for detecting structural variations.

Cell-based Analysis

Company Announcements

ACEA Biosciences, part of **Agilent Technologies**, joined the new **NSF Engineering Research Center for Cell Manufacturing Technologies** in November 2018. The company will work with the Krish Roy lab at **Georgia Tech University** to develop potency assays for CAR-T cells.

Bioprinting firm **CELLINK** announced in November 2018 the acquisition of **Dispendix**, a provider of high-throughput, noncontact dispensing products, for €5 million ($6 million).

In December 2018, **CELLINK** and **Prellis Biologics** partnered to commercialize high-resolution holographic bioprinting technology for micro-printing. The first bioprinting system offered by the two parties will be the CELLINK Holograph-X Bioprinter–Powered by Prellis Biologics and will have a retail price of approximately $1.2 million. The system will enable the first ever bioprinting of pre-vascularized tissue structures demonstrated to support tissue growth 10x larger than standard spheroid cultures.

In January, digital cell biology firm **Berkeley Lights** entered into a collaboration to explore multiple lines of inquiry aimed at advancing cellular therapies, including CAR-T therapeutics, with Megan Suhoski Davis, Director of the Product Development Laboratory at the **Center for Cellular Immunotherapies at the University of Pennsylvania's Perelman School of Medicine**.

Solentim, a provider of cell line-development instruments, entered into a technology partnership and collaboration agreement with bioengineering company **ATUM** in January. The collaboration will integrate Solentim's VIPS (verified in-situ plate seeding) hardware for isolating single cells with ATUM's Leap-In Transposase expression technology.

In January, picodroplet technology firm **Sphere Fluidics** and lab automation firm **Peak Analysis and Automation** (PAA) announced a collaboration to create automated microplate handling capabilities for single-cell analysis. PAA's SLAB plate handler will be integrated with Sphere Fluidics' CytoMine Single Cell Analysis System to help increase

throughput in antibody discovery and cell line development.

Sphere Fluidics closed a $2 million investment round in January. Investors include **Greenwood Way Capital**, **Oxford Technology** and **Innovations EIS Fund**, and **24Haymarket**.

1CellBio partnered with **Partek** in January to deliver a data analysis pipeline for its inDrop System single-cell transcriptomics platform for use within Partek Flow bioinformatics software.

In February, **Phase Holographic Imaging** (PHI) and **BioSpherix Medical** entered a collaboration agreement, aiming to co-market their respective hermetically sealed cell incubators, and complementary product lines and HoloMonitor M4 time-lapse cytometer, which is designed to continuously operate inside a cell incubator.

Product Introductions

BioTek Instruments introduced in October 2018 a Peltier Cooling Module for the Cytation Cell Imaging Multi-Mode Readers. The compact module keeps internal temperature rise to less than one degree over ambient.

In December 2018, **Berkeley Lights** launched a plasma B cell antibody discovery workflow for use on the Beacon Optofluidic Platform. It enables screening and assay time of 24 hours.

Molecular Devices, a **Danaher** company, announced in January several new features for its ImageXpress Pico automated cell imaging system, including environmental control and z-stack acquisition.

Sales and Orders of Note

In December 2018, **Novo Nordisk** purchased **Berkeley Lights**' Beacon Optofluidic platform to accelerate workflows in cell line development and for future protein and antibody discovery.

In January, **Harbour BioMed**, a global biopharmaceutical company, acquired **Berkeley Lights**' Beacon Optofluidic platform to implement accelerated workflows for single-cell screening and analysis.

In February, **ImmunoPrecise**, a full-service, therapeutic and diagnostic antibody discovery company, purchased a second Intellicyt iQue Screener PLUS from **Sartorius** for high-throughput cell-based screening.

Protein-based Analysis

Company Announcements

In November 2018, **Nicoya Life Sciences** designated the **National Center for Biological Sciences' Institute for Stem Cell Biology and Regenerative Medicine** in Bengaluru, India, as an OpenSPR Center of Excellence.

Fluidic Analytics raised $31 million in November 2018 in a round led by **Draper Esprit**. The company is developing the microfluidics-based Fluidity One System, built on a Fluidic Separation Detection Technology, to rapidly measure changes in protein size caused by folding, aggregation or interactions with other proteins in a biologically relevant context.

In January, **Unchained Labs**, which supplies instrumentation for biologics research, opened a new contract testing lab at its headquarters in Pleasanton, California, for providing identification of unwanted particles in drug products and quality assessment of the silicone layers on drug delivery devices.

In January, graphene biosensor firm **Nanomedical Diagnostics** changed its named to **Cardea**. The new name reflects implementation of a new business model that allows for OEM partnerships. The company also named Michael Heltzen as co-CEO. Current products and business activities under the Nanomedical Diagnostics-brand umbrella will continue under the shortened name Nanomed as a Cardea brand.

Product Introductions

In January, **Bio-Techne** introduced the CE-SDS PLUS system for its ProteinSimple-branded Maurice platform. It

includes a new cartridge, a novel sample buffer and a new version of “Compass for iCE” software to reduce undesirable protein fragmentation during separation.

Bio-Techne launched in January the 48-Digoxigenin cartridge, a new customizable cartridge format for the ProteinSimple-branded Ella immunoassay platform. The cartridge uses an anti-digoxigenin antibody on the surface of the Glass Nano Reactors (GNRs) to act as a universal capture, and users can impart specificity to the GNRs by introducing their own digoxigenin-labeled reagents.

In January, **Fluidigm** released the REAPseq (RNA expression and protein sequencing) protocol for use with its C1 system. C1 REAPseq is a multiomic single-cell application that enables deep characterization of unique cellular subtypes and functional states by measuring the expression of both cellular proteins and RNAs. It was was developed in collaboration with **Merck**.

Nanomed announced in January an early access program for the biosensor-based Revel, calling it the first high-throughput direct measurement platform for fragments and small molecules using orthogonal Field Effect Biosensing technology. Measuring up to 10 mM concentrations, the Revel is 24-channel direct binding system that is fully automated with a 48-hour walkaway run time. It is designed to be used with the Nimbus HD liquid handler from **Hamilton Robotics**.

Surface Science

Company Announcements

For the fiscal year ending September 30, 2018, **ZEISS** sales rose 8.8%, 12% on a constant currency basis, to €5.817 billion ($6.686 billion). Sales for the Industrial Quality & Research division, which consists of metrology and microscopy solutions, grew 0.7%, 4% in constant currency, to make up 27% of revenues. In constant currency, microscopy sales were flat.

The **Max Planck Florida Institute for Neuroscience** (MPFI) announced in January a “labs@location” partnership agreement between its Electron Microscopy Core Facility and **ZEISS** for brain research. MPFI will have access to ZEISS technology before it is commercially available. MPFI is the third US institution to earn the labs@location designation. The first piece of equipment made available to MPFI scientists is known as the “Focal Charge Compensation module (FCC),” which is integrated onto a Serial Block Face SEM system. The parties have collaborated since 2012.

In December 2018, **3i (Intelligent Imaging Innovations)**, a provider of advanced multimodal microscopy systems, entered into a strategic partnership with **DRVISION** Technologies to deliver AI-enabled software for visualization, exploration and analysis of microscopy images of virtually any size. The partnership enables 3i to market and sell DRVISION’s Aivia, while DRVISION will further expand its support for SLD (SlideBook) files to ensure performance 3i system users.

In January, **Olympus** announced a co-development partnership with the **University of Southern California** (USC), the USC-Olympus Innovation Partnership in Multiscale Bioimaging, for the goal of advancing multiscale research into cancer prevention, diagnosis, and treatment through precision medicine. The partnership involves USC’s **Lawrence J. Ellison Institute for Transformative Medicine** and **Translational Imaging Center**.

In January, **Oxford Instruments Asylum Research** opened a sales and support office to serve the eastern US. The office is collocated at Oxford Instruments’ US headquarters in Concord, Massachusetts.

In February, the **University of California San Diego** and **Leica Microsystems** established the Leica Microsystems Center of Excellence. The Center features confocal microscopy technology from Leica, including FALCON fast lifetime contrast fluorescence imaging, as well as STED (stimulated emission depletion), multiphoton and confocal super-resolution microscopy systems.

Product Introductions

In December 2018, **ZEISS** introduced the ZEISS Elyra 7 with Lattice SIM (structured illumination microscopy), a new flexible platform for fast and gentle 3D super-resolution microscopy. It enables fast imaging of 3D volumes at up to 120 nm laterally. The ZEISS Elyra 7 can be expanded with single-molecule localization microscopy techniques.

In January, **ZEISS** released the ZEISS Xradia 610 and 620 Versa X-ray microscopes for x-ray computed tomography, two new models in its ZEISS Xradia Versa family. They are designed for submicro-resolution imaging of intact samples.

In January, **DeNovix** introduced the CellDrop Automated Cell Counter, the first instrument to incorporate its DirectPipette Technology, removing the need for expensive, environmentally damaging plastic slides. It allows measurements across a range of cell densities, 7×10^2 to 4×10^7 cells, without the need for dilution or concentration. CellDrop is available in dual-fluorescence and brightfield or brightfield-only models.

JEOL Japan launched in December 2018 the JEM-ACE200F high-throughput TEM. It can work with pre-programmed modes for unattended operation. The annual sales target is 30 units.

Bruker launched in January the JPK NanoWizard ULTRA Speed 2 AFM system for life science bioimaging. It features a scanning speed of 10 frames per second and a new, workflow-based software graphical user interface.

In February, **Bruker** introduced the SKYSCAN *1273* 3D x-ray microscopy based on micro-computed tomography technology. Samples of up to 500 mm length, 300 mm diameter and a maximum weight of 20 kg can be investigated.

CELLINK released in February the CellCyte X live-cell microscope for use in an incubator. It features a software-based link to the company's bioprinting system.

In February, **Thermo Fisher Scientific** launched the automated Invitrogen EVOS M7000 fluorescence microscope featuring a high-end camera and more powerful computer. The EVOS M7000 microscope builds on the strengths of its predecessors, the EVOS FL Auto and FL Auto 2 cell imaging systems, with an upgraded XE3 computer and a Quadro graphics card to significantly reduce time acquiring and saving images

Sales and Orders of Note

In December 2018, the German Research Foundation (DFG) announced the funding of three high-performance super-resolution microscopes from **Abberior Instruments**, two MINFLUX nanoscopes and an intravital STED microscope equipped with DyMIN (live-cell STED with Dynamic Minimum), as part of the major instrumentation initiative.

Confocal.nl announced in December 2018 that the **Luxemburg Center for Systems Biomedicine** is utilizing its Re-scan confocal microscope for its research into neurodegenerative disorders.

In January, **Confocal.nl** announced that the **ETH Zurich's Scientific Center for Optical and Electron Microscopy** selected its Re-scan confocal microscopy module for a STORM (stochastic optical reconstruction microscopy*)* system.

In January, Czech Republic–based **Charles University Centre of Advanced Materials** installed the **JEOL** JEM-NEOARM 200 TEM in its new electron microscopy lab.

Atomic Spectroscopy

Company Announcements

The US **Federal Trade Commission** approved in October 2018 **Agilent Technologies**' application for the cross license with **Analytik Jena** of certain intellectual property connected to ICP-MS (see ***IBO*** 3/31/18).

In January, **Fraunhofer IISB** and **Rigaku Europe** entered into a strategic partnership in order to support the European semiconductor industry in improving and better understanding its wafer quality and yield by employing the Rigaku XRTmicron advanced x-ray topography tool. Fraunhofer IISB will act as a demo center for the XRTmicron system in Europe.

In February, **Heuresis**, which supplies handheld XRF systems, changed its name to **Viken Detection**.

Product Introductions

In January, **Advion**, a **Beijing Bohui Innovation Biotechnology** company, introduced the SOLATION ICP-MS, featuring a 90° quadrupole deflector for lower interference and improved signal-to-noise ratio.

Bruker launched in January the G6 LEONARDO inert gas fusion analyzer for oxygen, nitrogen and hydrogen concentration measurements in inorganic samples. The system introduces Bruker SampleCare features into IGF-analysis for metals and ceramics. It features pre-calibrated standard methods and the use of argon carrier gas instead of helium.

In January, **Analytik Jen**a released the PlasmaQuant MS Q, which is optimized for high-throughput applications, and the PlasmaQuant MS Elite S for routine analysis of ultratraces. Depending on the matrix load of the samples and the individual performance requirements for sensitivity and throughput, analysis of more than 80 samples per hour is possible.

In February, **SPECTRO Analytical Instruments**, an **AMETEK** company, debuted the SPECTROGREEN ICP-OES analyzers, featuring the new Dual Side-On Interface and stating that the Interface achieves twice the sensitivity of conventional radial plasma-view instruments at an affordable price/performance ratio.

XOS, a **Danaher** company, launched in February the portable Cadence, an HRXRF-based multi-element analyzer for detection for heavy metals in soil and powder matrices. Applications include environmental remediation.

Sales and Orders of Note

In February, **Hitachi High-Tech Analytical Science** announced a supply agreement with **Wilhelmsen Ships Service** to supply its X-MET8000 handheld XRF systems for testing the sulphur content of ship fuel.

Materials Characterization

Company Announcements

In December 2018, nanoparticle analyzer firm **Spectradyne** announced a partnership with **Particle Technology Labs** to provide analytical measurement services using its nCS1 instrument.

Halo Labs, developer of the Horizon subvisible particle analysis instrument, closed a $5.6 million Series B financing round in December 2018, led by **Research Corporation Technologies**.

In January, **Buehler**, an **Illinois Tool Works** company and hardness tester manufacturer, named Julien Noel as vice president and general manager of the Buehler Worldwide Division. He most recently served as Americas commercial

director in addition to global director of Strategy and Innovation.

Product Introductions

In January, **TA Instruments**, a **Waters** company, introduced the High Sensitivity Pressure Cell for the ARESG2 Rheometer. The accessory enables scientists to perform sensitive viscoelastic measurements under controlled atmospheric pressure and temperature and for the first time, gain detailed understanding of complex fluid behavior in complex environments.

Spheryx launched in January the xSight particle characterization instrument, based on Total Holographic Characterization, capable of detecting, counting and characterizing sub-visible particles in complex heterogeneous mixtures. New features include multi-color laser sources and temperature control as well as custom disposable eight-channel microfluidic sample chips.

In January, **Buehler** debuted the UH4000 Series universal hardness tester, which is available in two models, the UH4250 Hardness Scale 0.5–250 kgf and the UH4750 Hardness Scale 3–750 kgf. Features include a new eight-position turret.

In February, **Koehler Instrument** introduced the new K77000 Automated Pour Point Analyzer for measuring pour point by the Automatic Tilt Method ASTM D5950. It covers a wide temperature range and can reach temperatures down to -105°C.

Shimadzu Scientific Instruments released in February the LabSolutions TA Software for thermal analyzers. Network compatible, the software features a new design and enhanced functions, including automatic manipulation and automatic analysis functions in template format.

Reported Financial Results

$ in Millions USD	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
AMETEK	Q4	31-Dec	$1,271.3	11.2%	$282.0	24.5%	$211.5	-11.3%
AMETEK	FYE	31-Dec	$4,845.9	12.7%	$1,075.5	19.0%	$777.9	14.2%
AMETEK (Electronic Instruments Group)	Q4	31-Dec	$826.0	11.4%	$214.6	13.2%	NA	NA
AMETEK (Electronic Instruments Group)	FYE	31-Dec	$3,029.0	12.6%	$782.1	16.5%	NA	NA
Avantor*	FYE	31-Dec	$1,247.4	80.4%	-$210.4	NM	-$145.3	-80.0%
Avantor**	9 mo.	30-Sep	$4,390.4	748.1%	$314.2	486.2%	-$33.6	-68.8%
Becton, Dickinson***	Q1	31-Dec	$4,160.0	35.1%	$888.0	277.9%	$599.0	NM
Becton, Dickinson (Life Sciences)***	Q1	31-Dec	$1,056.0	1.1%	$305.0	-3.5%	NA	NA
Bioanalytical Systems (Products)***	Q1	31-Dec	$0.9	4.5%	$0.04	272.7%	-$0.1	NM
Bio-Techne****	Q2	31-Dec	$174.5	13.2%	$33.6	39.2%	$17.6	-64.1%
Bio-Techne (Protein Sciences)****	Q2	31-Dec	$135.5	15.6%	$59.0	17.4%	NA	NA
Bio-Techne (Diagnostics & Genomics)****	Q2	31-Dec	$39.2	5.8%	($1.1)	NM	NA	NA
Brooks Automation***	Q1	31-Dec	$179.4	25.8%	$5.3	8.3%	$14.4	-12.6%
Brooks Automation (Life Sciences)***	Q1	31-Dec	$66.7	40.5%	$1.6	NM	NA	NA
Bruker	Q4	31-Dec	$553.6	4.4%	$106.4	11.6%	$78.1	NM
Bruker	FYE	31-Dec	$1,895.6	7.3%	$262.4	19.5%	$179.7	128.6%
Bruker (Scientific Instruments)	Q4	31-Dec	$500.5	3.3%	$101.4	4.6%	NA	NA
Bruker (Scientific Instruments)	FYE	31-Dec	$1,707.0	7.8%	$247.9	16.2%	NA	NA
Bruker (Energy & Supercon Technologies)	Q4	31-Dec	$55.6	9.0%	$5.2	67.7%	NA	NA
Bruker (Energy & Supercon Technologies)	FYE	31-Dec	$194.8	1.9%	$14.5	95.9%	NA	NA
Fluidigm	Q4	31-Dec	$32.3	16.5%	$29.9	30.0%	($14.8)	-41.3%
Fluidigm	FYE	31-Dec	$113.0	10.8%	$109.8	-0.5%	($59.0)	2.5%
Honeywell (Perf. Materials & Tech.)	Q4	31-Dec	$2,854.0	1.9%	$2,206.0	-5.2%	NA	NA
Honeywell (Perf. Materials & Tech.)	FYE	31-Dec	$10,339.0	-3.1%	$607.0	-6.9%	NA	NA
IDEX (Health & Sci Tech.)	Q4	31-Dec	$225.5	7.9%	$52.2	16.0%	NA	NA
IDEX (Health & Sci Tech.)	FYE	31-Dec	$896.4	9.3%	$205.7	14.5%	NA	NA
Illinois Tool Works	Q4	31-Dec	$3,580.0	-1.4%	$860.0	1.7%	$607.0	NM
Illinois Tool Works	FYE	31-Dec	$14,768.0	3.2%	$3,584.0	2.8%	$2,563.0	51.9%
Luminex	Q4	31-Dec	$81.3	4.0%	$1.0	-89.4%	($2.3)	22.6%
Luminex	FYE	31-Dec	$315.8	3.0%	$27.8	-25.1%	$18.5	-37.1%
Mettler-Toledo	Q4	31-Dec	$817.9	5.1%	$230.5	18.9%	$181.2	135.4%
Mettler-Toledo	FYE	31-Dec	$2,935.6	7.7%	$651.9	13.5%	$512.6	36.3%
MTS Systems***	Q1	31-Dec	$203.2	4.6%	$18.0	8.9%	$10.5	-68.3%
Pacific BioSciences	Q4	31-Dec	$19.5	-21.7%	($30.6)	-49.2%	($30.8)	-48.3%
Pacific BioSciences	FYE	31-Dec	$78.6	-15.9%	($101.0)	-12.5%	($102.6)	-11.3%
QIAGEN	Q4	31-Dec	$403.2	1.6%	$88.3	103.5%	$60.9	NM
QIAGEN	FYE	31-Dec	$1,501.8	5.9%	$266.6	73.8%	$190.4	371.3%
Roper Technologies	Q4	31-Dec	$1,376.3	12.2%	$364.4	5.0%	$257.1	-42.1%
Roper Technologies	FYE	31-Dec	$5,191.2	12.7%	$1,396.4	15.4%	$944.4	-2.8%
Roper Technologies (Medical & Scientific Imaging)	Q4	31-Dec	$402.4	9.4%	$141.9	9.2%	NA	NA
Roper Technologies (Medical & Scientific Imaging)	FYE	31-Dec	$1,522.4	7.9%	$521.0	7.1%	NA	NA
Roper Technologies (Energy Systems & Controls)	Q4	31-Dec	$162.1	1.1%	$57.4	11.0%	NA	NA
Roper Technologies (Energy Systems & Controls)	FYE	31-Dec	$600.4	8.9%	$180.8	19.6%	NA	NA
Twist Bioscience***	Q1	31-Dec	$11.5	166.5%	($22.9)	-36.7%	($22.6)	-33.7%
Other Currencies (in Millions)								
Biotage	Q4	31-Dec	SEK 234.60	24.2%	SEK 35.70	10.9%	SEK 27.30	-21.1%
Biotage	FYE	31-Dec	SEK 910.90	21.8%	SEK 172.50	29.1%	SEK 167.60	20.8%
DKK-TOA*****	Q3	31-Dec	¥4.06	31.3%	¥0.36	101.7%	¥0.20	179.5%
GL Sciences*****	Q3	31-Dec	¥18.3	9.2%	¥2.307	32.2%	¥1.5	26.5%
HORIBA	Q4	31-Dec	¥64.54	2.3%	¥10.96	-10.3%	¥8.84	60.8%
HORIBA	FYE	31-Dec	¥210.57	7.8%	¥28.84	7.5%	¥22.31	37.0%
HORIBA (Process & Environmental)	Q4	31-Dec	¥5.86	8.6%	¥0.84	25.6%	NA	NA
HORIBA (Process & Environmental)	FYE	31-Dec	¥19.36	11.1%	¥2.03	85.3%	NA	NA
HORIBA (Scientific Instruments)	Q4	31-Dec	¥8.21	-1.6%	¥0.64	-35.9%	NA	NA
HORIBA (Scientific Instruments)	FYE	31-Dec	¥27.75	6.3%	¥0.22	-55.6%	NA	NA
Ilmmuno-Biological Laboratories*****	Q3	31-Dec	¥578.78	14.6%	-¥65.72	0.8%	-¥76.06	-11.1%
Olympus (Scientific Solutions)*****	9 mo.	31-Dec	¥581.05	1.6%	¥20.58	-65.6%	¥6.53	-86.4%
Syft Technologies******	FYE	31-Mar	NZD 12.39	50.0%	NZD 6.89	58.0%	NZD 3.58	210.1%

*=*For fiscal year ending December 31, 2017*
**=*For fiscal year ending December 31, 2018*
***=*For fiscal year ending September 30, 2019*

****=*For fiscal year ending June 30, 2019*
*****=*For fiscal year ending March 31, 2019*
******=*For fiscal year ending March 31, 2018*
NA = not available, NM = not material
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