



IBO

Strategic Information for the
Life Science and Analytical
Instrument Industry

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Pittcon Attendance Increases as Conference Moves North

This year, Pittcon traveled to Philadelphia, Pennsylvania. The conference and exhibition ran from March 16 to March 21, attracting 12,542 attendees, according to organizers' estimates as of March 21. Final figures were not available at the time of publication. This would be a 9.9% increase from last year's event in Orlando, Florida (see [IBO 3/15/18](#)). Next year's Pittcon will be held March 1-5 in Chicago, Illinois.

Seven hundred and thirteen exhibitors were on the floor, the same as a year ago. Exhibitors returning to the show this year after not exhibiting last year included Mettler-Toledo and Sartorius. Absent this year were Eppendorf and Ocean Optics, among others. Also, many companies had reduced their booth size compared to past years, including Bruker, Hach and Thermo Fisher Scientific.

Although Pittcon may not be the hub of press announcements and new products that it once was, the show did mark announcements by Rigaku and Anton Paar. Rigaku debuted a new branding strategy to highlight the unification of the company's operational units. Anton Paar USA detailed changes to its operational structure, forming four regional organizations in order to be closer to its customer base, provide faster response times and offer more training centers.

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Companies were especially focused on ease of use and solutions that extend beyond instrumentation alone, most notably larger firms, according to press conference presentations and new product introductions. As noted at their press events, for Shimadzu Scientific Instruments (SSI), Thermo Fisher Scientific and Waters, ease of use is designed to grow the markets for LC/MS and other instrumentation techniques into new applications and user bases, promising increased productivity with quicker turnaround and less operator training.

A key enabler for great ease of use is software, and many companies highlighted new interactive capabilities that are fully integrated into their systems, including automated instrument set-up and monitoring as well as user guidance, and remote system diagnostics. Instruments showcasing these new features included Waters' BioAccord LC/MS (see [Pittcon 2019 New Product Highlights](#)) and SSI's Nexera UHPLC series (see [IBO's Top New Products at Pittcon 2019](#)).

Software was also a topic at Bruker's press conference. The company discussed its two recent software company purchases of Arxspan (see [IBO 3/15/19](#)) and a majority stake in Mestrelab ([IBO 12/15/18](#)), and commented that it plans to build a dedicated software business. Arxspan provides cloud-based solutions for the biopharma market, while Mestrelab, a chemistry software provider, supports data processing as well as data analysis for techniques such as NMR, MS and molecular spectroscopy across a range of markets. At its press conference, JEOL took the opportunity to highlight additional developments in CRAFT (Complete Reduction to Amplitude Frequency Table) software for NMR, developed by Dr. Krish Krishnamurthy, which uses Bayesian analysis to provide direct time-domain analysis of spectra.

Software was also discussed as part of companies' ongoing goal to meet customers' need for complete workflows and application-focused solutions. Systems announced at the show to address specific applications included Bruker's MIRA IR-based solution for milk analysis, as well as the Thermo Scientific's Beer Craft software package for its GENESYS UV-Vis instruments (see [Pittcon 2019 New Product Highlights](#)), and its dedicated cannabis analyzer and workflow available for sale in Canada. Waters emphasized how the new BioAccord system is more than an LC/MS system, emphasizing the company's new focus on fit-for-purpose solutions.

Waters also detailed two planned application-based introductions for the system, which will address synthetic peptide and synthetic oligonucleotide analysis based on new software and consumables. Other product previews disclosed at companies' press conferences were SSI's semi-prep SFC system (see [Pittcon 2019 New Product Highlights](#)), developed in cooperation with the Enabling Technologies Consortium, which was formed by pharmaceutical and biotech companies to collaborate on pre-competitive solutions. Metrohm announced that its latest titrator, the EcoTitrator, an entry-level affordable system meant to replace hanging glass burettes, will be introduced later this spring.

Similarly emphasizing more workflow-oriented solutions from the company, Thermo Fisher debuted a dedicated workflow for dioxin testing, the Thermo Scientific Dioxin Analyzer. Among its components are the company's sample preparation consumables, TSQ 9000 triple quadrupole GC-MS/MS system with Advanced Electron Ion source, columns and software for isotope dilution quantification. The company called it one of the first workflow launches from its Customer Solution Centers. Highlighting the Centers, the company described them as dedicated to method development and customer collaboration, for example, versus a previous instrument-centered focus. JEOL also

unveiled a solution for dioxin testing in the form of its JMS-TQ4000GC, which is distinguished by several features, including a short 15 mm collision cell and a detector that shuts off between pulses in order to reduce noise.

SSI announced a dedicated Hemp Analyzer system, providing a choice of 3 HPLC methods and available with a 3-year warranty and preventive maintenance. Also highlighting its solutions for cannabis testing was Spectro Analytical, with an electrothermal vaporation ICP for analysis of heavy metals in plant tissue for direct sample entry with no dilution required. Touting end-to-end solutions was labware firm DWK, with consumables for research, such as sampling storage, sample preparation and commercialization. Its industrial workflows cover collection, preparation, processing, testing and analysis.

As SSI has extended its cannabis testing solutions with new systems, TA Instruments discussed the ongoing extension of its materials testing products through additional accessories for its Discovery Series, including a microscopy extension for DSC and humidity system for its new hybrid rheometer(see [Pittcon 2019 New Product Highlights](#)). Also adding to existing product lines was CEM which released Disposable Glass Liners for use with its MARSXpress Plus vessels to relieve the bottleneck of vessel handling and cleaning. At its booth, Metrohm displayed an extension to its OMNIS titrator platform to include Karl Fischer moisture analysis.

As with Waters' BioAccord, some companies also indicated an emphasis on systems designed to move closer to late-stage biologics development and even manufacturing. CEM discussed the third-generation of its Liberty Prime peptide synthesizer system for scale-up for peptide drug development. The company stated that advantages include speed with the ability to make 1 kg of peptides in one day and thus the capability to address personalized medicine to meet patient needs quickly.

Also at press conferences, two private companies updated their sales information. Anton Paar, announced 2018 sales of €366 million (\$431 million at €0.85 = \$1), with 20% of sales invested in R&D. CEM revenues totaled \$102 million last year, with 12.5% of sales going toward R&D. Raman microscopy firm WITec disclosed an installed base of more than one thousand microscopes. The success of such companies demonstrates the analytical instrument industry, both bigger companies and smaller companies, continue to meet customer needs.



COMING THIS MONTH

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Year Forecast

- This report provides detailed data on every major life science and analytical instrument technology in the industry, enabling you and your staff to make accurate evaluations and informed decisions.
- Includes market sizing for **2018 and forecasts through 2023**.
- Each instrument technique includes data and discussion of market segmentation by **product, industry, function, and region**.
- **Vendor share data** for 2018, a chart of vendor participation versus product area for all significant suppliers.
- A brief description of **related business developments** and/or significant product introductions for each instrument technique section.

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Instrument Companies Embrace Accessibility, Data Integration and Complete Workflows

On the occasion of the annual Pittcon conference and exhibition, *IBO* sat down with senior executives from three major instrument system and lab product suppliers—Shimadzu Scientific Instruments (SSI) (the North American unit of Japanese firm Shimadzu), Thermo Fisher Scientific and Waters. Discussing company priorities, R&D approaches and the current state of informatics development, the companies indicated the influence of major industry themes such as increasing instrument ease of use to growth usage, integrating larger amounts of data and access to them, and providing more tightly integrated workflow solutions.

As the world's largest analytical instrument and lab product company, Thermo Fisher Scientific is in a unique position to provide complete workflows, according to Dan Shine, senior vice president and president of the Analytical Instruments Group. In fact, as he told *IBO*, this is one of the Analytical Instruments Group's priorities this year. This is because more complete workflow solutions increase a lab's productivity. "[Customers] are under increasing pressure to get more samples analyzed more quickly and make use of the data," he explained. "So we're doing a lot on both the front end, with sample prep, and the back end, data analysis and data integrity, to automate that process as best we can and put the pieces together."

"That's an overarching goal we have: to make things simpler and easier to use."

In addition, workflows create market opportunities "One thing we've seen over time as we make the systems easier to use, is a broader use of the instruments versus the need for PhD-level scientists to run the analysis," explained Mr. Shine. "That's an overarching goal we have: to make things simpler and easier to use." He cited the [Thermo Scientific Cascadion SM Clinical Analyzer](#), which draws upon the company's MS, automation, clinical and software offerings, among other capabilities for a turnkey solution, as an example. Another example is an end-to-end dioxin analysis workflow the company launched at Pittcon, encompassing all steps from sample preparation to data

analysis.

The combination of its products to create end-to-end solutions as well new system configurations and options is one of the factors that distinguishes Thermo Fisher's R&D, according to Mr. Shine. "There are two things that really help differentiate us: the breadth of our technologies and how we can integrate them," he noted. "This is challenging to do as separate companies because people are concerned about things like sharing intellectual property or how things work," he said.

Likewise, integration can enable more productive workflows and efficient customer service. "Sometimes when you have multiple companies owning different parts of a workflow, you have people pointing to each other when there's a problem. 'It's not me, it's them.' Then it takes a while to resolve the problem, to just figure out where the issue is," commented Mr Shine. "If you sold them the complete workflow, you own the problem and you have to solve it. This ultimately leads to a better customer experience."

A key part of the company's R&D investments is informatics. As Mr. Shine explained, "We've invested a lot in infrastructure, whether it's the Thermo Fisher Cloud or a different SAP-type backbone, but now it is really about how we connect it all together to drive customer benefit." Such benefits include improved service offerings, including an ability to diagnose a problem remotely and thus send a service engineer with the right part. "First-time fix is a big thing to drive improvements for our customers." This also makes the service organization more effective. "It takes a lot to train the field service engineer," he explained. "If we can leverage the expertise remotely, it makes that person that much more effective in front of the customer."

"It's about connecting two data points that can actually lead to a breakthrough."

However, at a higher level, informatics drive data integration, which can improve research outcomes "When I think about our instruments, they generate so much data and the customers generate so much data that we need to help them understand all of it, how to make sense of it, to find that needle in the haystack, find that discovery that hasn't been made yet," said Mr Shine. "It's about connecting two data points that can actually lead to a breakthrough. So I think that is where we're going—how do we take data science and machine learning and apply that to different, disparate datasets. Helping customers do that will unlock discoveries."

R&D is also among Waters' priorities this year, as the company expects a steady streams of new product introductions, a development that in recent years has been led by the company's TA Instruments segment. Terry Kelly, senior vice president and president of TA Instruments, told **IBO**, "From a TA perspective, our priorities haven't changed. It's really staying in a new product rhythm. We've got a pretty robust pipeline of new products." For the Waters division, introduction of new offerings are increasing, with a new product portfolio a priority for the year. "I think for Waters, unlike TA, we've had a slower new product cadence over the last couple of years. The good news is you'll see, as we go through the year, that we have a lot more new products to introduce," explained Jeff Mazzeo, PhD, vice president of Marketing at Waters.

With the new products, Waters plans to enhance its market focus. "The other priority is to really continue to focus on the market segments we serve," said Dr. Mazzeo. "[A]t least from a Waters' product standpoint, we were very technology 'out' in the past. We are now trying to focus more on customer input 'in,' and that's where the market segment teams really have to understand what do our customers need to be successful with our technology today, and so how do we build the right products for the future."

"We are really trying to bring LC/MS much closer and integrated together."

In fact, the increased R&D investment at the company is part of what makes the Waters' R&D stand out. As Mr. Kelly put it, "Not only is it a sustained investment in R&D, but it is an accelerating investment in R&D. [Chairman and CEO] Chris O'Connell has really led the charge to increase our investment in R&D." R&D investment is also integral to the company's aim to broaden the base of LC/MS users. "We are really trying to bring LC/MS much closer and integrated together," stated Dr. Mazzeo. "That strategy is one of the things that we're going to evolve to: how do we make LC/MS more broadly applicable and deployable across all of our market segments."

In line with this goal is Waters' focus on expertise, which Dr. Mazzeo highlighted as another R&D differentiator. "I

think what also makes us different is the application expertise we have. It's always been a difference for Waters, and what we're trying to do with transformational engineering and the [BioAccord](#), which is the first version of this, is how to we embed our application expertise into the product from a workflow standpoint," he emphasized. "So our whole goal is really try to decentralize LC/MS." In the case of the BioAccord, this is expanding the use of LC/MS in biopharmaceutical labs further downstream.

R&D investments also encompass acquisitions, such as Waters' 2018 purchase of the DESI (desorption electrospray ionization) technology (see [IBO 7/31/18](#)). "We think that there is the potential to move imaging in general into the pathology laboratory, whether it's DESI or through other direct ionization techniques," explained Dr. Mazzeo. "We think DESI could be a part of that long term and that is why we made that investment. But in the short term, there's a lot of opportunity for DESI just in biomedical research."

"Waters Connect is a way for us to deliver increasingly more value to our customers with greater insight, faster deployment and business flexibility."

The company is also concentrating on the short and long term with its informatics offerings. These plans include not only building upon the strong base of Empower CDS (chromatography data system) users with the UNIFI platform, but an integration of its current informatics product lines. The company's latest platform, Connect, will debut next year. Describing Connect, Dr. Mazzeo commented, "It will be a single platform built on top of a modern, cloud-ready architecture with compliance designed into its core that will feature an ecosystem of newly created web-based apps into which data from existing Waters software solutions can be ported." He added, "Waters Connect is a way for us to deliver increasingly more value to our customers with greater insight, faster deployment and business flexibility."

For SSI, priorities this year also include workflow solutions as well as new markets. As Patrick Fromal, vice president of sales for SSI, told [IBO](#), "We see our position around HPLC enhancing greatly in pharma, in environmental [and] the emerging markets of cannabis and hemp." In particular, he views hemp as a new growth opportunity. At its Pittcon press conference, the company highlighted a new dedicated HPLC-based hemp analyzer. "With hemp being a major row crop, its legalization will have a major impact on industry itself, because of all the different materials that can be used from hemp." These materials include textiles and packaging.

This testing market will grow thanks to the federal legalization of hemp in the US in late 2018, according to Mr Fromal. "[The Farm Bill](#) that passed in December says, 'Yes, hemp is legal as long as it is below a certain level of THC.' So they are going to have to ensure that the products meet those restrictions. That's one testing aspect," explained Mr. Fromal. "But then I think the other aspect is what levels of CBDs [producers] can extract from the crop itself, so now they are going to want to do product quality testing. That will probably be from some growers [and] producers, but I think this is the early onset [of demand, and] from maybe some contract research labs as well."

In addition to addressing new markets, SSI is also expanding its existing informatics offerings to additional technologies and instruments. Mr. Fromal discussed the ability to use its LabSolutions data management software with many of the company's instrument platforms in its technology portfolio, such as chromatography systems, spectrometers and thermal analyzers. He also highlighted SSI's Insight quantitation software for data processing and analysis. "We have another package currently integrated with our MS software, with chromatography to follow, called Insight. This is data review software for faster quantitative analysis," he noted. For MS, this includes data processing and peak integration. But it is also designed to streamline data review, for instance, explained Mr. Fromal. "With color-coded flags and flexible searching/filtering, it puts data into an easily displayed format so users can easily review items, click on each box for 'yes, pass' and send it on for verification, [then] sign off and review." The company's new Nexera HPLC Series (see [IBO's Top Three New Products at Pittcon 2019](#)) provides new instrument software capabilities for its LC portfolio, including unattended operation and automatic diagnostics and recovery.

"We see analytical instruments getting closer and closer to the patient."

In addition to software innovation, SSI, as part of Shimadzu, is also more closely integrating analytical instruments' R&D with another of its divisions. "Shimadzu is one of the few analytical companies that also has a medical division. In recent years, Shimadzu has urged its R&D engineers from both the analytical and medical divisions to work more

closely together," Mr. Fromal noted. "Shimadzu wants to see greater cross collaboration because, quite honestly, we see the analytical instruments getting closer and closer to the patient." He added, "We envision someday that an MS will be in an operating room."

For SSI, Thermo Fisher and Waters, realizing such growth opportunities, whether in end-user markets, such as clinical testing, or product markets, such as lab data software, will require creating complete solutions and easier workflows, as well as capitalizing on ongoing developments in informatics.

IBO's Top Three New Products at Pittcon 2019

IBO chooses among the many new product introductions at Pittcon each year to recognize three that were particularly notable for advancing analytical technology, as well as representing innovation and commercial potential.

Gold Award

Tosoh Bioscience launched at Pittcon a new type of static light scattering detector for HPLC, UHPLC and GPC/SEC for sale in the Americas. The LenS₃ Multi-Angle Light Scattering (MALS) detector measures molecular weight and radius of gyration of macromolecules. This is the company's first light scattering product launch since the 1970s. The LenS₃ MALS detector features an innovative optical design, cell-block assembly and calculation method, which has led to a new advancement in light scattering technology.

In contrast to the typical three-angle MALS detector design, the LenS₃ system allows for measurements at lower and higher angles, essentially combining low-angle light scattering, right-angle light scattering and MALS angles, and the benefits of all three into one system. This enables the analysis of the radius gyration of particles less than 10-12 nm in size. The system is capable of analyzing synthetic polymers, proteins, peptides and other complex macromolecules.

This instrument also features a patent-pending optics design and a lower-wavelength green laser at 514 nm for a higher scattering intensity. Sensitivity is also increased through the use of a unique "flow chamber," replacing the standard optical cell. The design maximizes path length for greater interaction with the solute molecules and minimizes refraction by limiting stray scattering.

The company stated that the LenS₃ provides the highest sensitivity level of any static light scattering detector on the market. The detector allows for an easy interchange between an HPLC and UHPLC system via a service kit.



Click to enlarge

Silver Award

Shimadzu Scientific Instruments launched its newest Nexera UHPLC series, the next generation of its Nexera series. The system integrates a new design and new level of automation to advance productivity to increase time savings for operators.

The Nexera LC-40 UHPLC instruments integrates AI technologies into the system to improve efficiency of user workflows, which is branded as “Analytical Intelligence.” This technology allows the system to detect and resolve issues automatically and reduce instrument downtime due to analysis issues, such as flow anomalies caused by the presence of air bubbles in the mobile phase. The system monitors baseline changes, including any fluctuations, and when abnormalities are detected, it will pause the analysis, purge the flow path and restart the run once normal conditions are recovered. The system also promotes the integration of IoT to check instrument status and incorporates online customer support.

The AI technology additionally facilitates a fully unattended workflow from startup to shut down. Users can set the system to start at a specified time, which allows the instrument to complete auto-purge, equilibration, baseline checks and optimize parameters. Once users set up the system for analysis in advance, they can leave it unattended and check the status and predicted analysis completion time remotely through a smart device. The FlowPilot feature will increase the flow rate gradually to the set point.

The Nexera UHPLC offers a real time mobile phase-level measurement through its weight sensors, which can monitor up to 12 containers of mobile phase and other solutions. In addition, the system also tracks consumables usage. The new SIL-40 autosampler boasts an injection cycle time of seven seconds and non-stop temperature-controlled analysis of thousands of samples. Shipments start in April, with an expected 10%-20% price increase compared to previous UHPLC model.



Click to enlarge

Bronze Award

AMETEK SPECTRO Analytical highlighted the launch of its new SPECTROGREEN inductively coupled plasma optical emission spectrometer (ICP). The system incorporates a couple key innovations. Foremost is the Dual Side-On Interface, which uses a single mirror to effectively double the amount of light that reaches the detector from the vertically oriented torch, leading to significant improvements in sensitivity compared to other radial view systems and even with axial view ICP.

This positions the SPECTROGREEN to be able to handle most common applications for ICP, including those that more typically require axial or dual-view systems, but without a significant price increase. The system's 15 linear Hamamatsu CMOS detectors also provide improvements over the much more commonly used CCD detectors, such as the elimination of blooming problems, broad dynamic range and rapid analysis, enabling the study of transient signals. Each detector has 4,096 pixels, enabling resolution of 8 pm for some wavelength ranges. The detectors also do not require cooling, which is another advantage, and analysis can be done rapidly enough to enable transient analysis.

SPECTRO's UV-Plus design (available in some other SPECTRO instruments) also provides cost savings, since the optical system is sealed with argon inside, obviating the need to purge the system repeatedly. The system incorporates some features of the SPECTROBLUE ICP introduced a few years ago, but while the SPECTROBLUE is configured primarily for environmental applications, the SPECTROGREEN can quite flexibly address a broad array

of applications from fuel to food to consumer product safety testing. The system is now in production and ready for sale, with a price of about \$65,000, with a complete system with autosampler in the mid-\$70,000s.



Click to enlarge

Pittcon 2019 New Product Highlights: Part 1

Atomic Spectroscopy

Advion introduced the SOLATION ICP-MS system, which offers multi-element analysis for diverse laboratory applications in a variety of industries, including environmental, food, pharmaceutical and clinical. The instrument features a 90° quadrupole deflector that prevents contaminants from entering the analyzer, and offers both pulse and analog detection modes with seamless transmission in a single analysis. The system is delivered with a suite of software, including ICP-MS Express, which allows the user to quickly set up runs, control the instrument peripherals and optimize data collection. The instrument began shipping in January for a price of around \$130,000.

Bruker's S2 Polar, unveiled in October 2018, was featured at the booth of Bruker's US partner, **Quantum Analytix**. This system is a benchtop ED-XRF designed specifically for petrochemical applications. While it is engineered to meet certain specific measurements for ultra-low sulfur, the system is not specific to sulfur and can measure other elements of importance to refineries or in the study of wear metals in lubricants.

Discussed at Bruker's press conference, but not on display at the booth, was the G6 Leonardo, launched in January. The system is designed for measuring trace oxygen, nitrogen or hydrogen primarily in metal samples, such as steel. The system uses inert gas fusion, and utilizes non-dispersive IR for the oxygen measurements, and thermal conductivity for nitrogen or hydrogen analysis.

Xplorex showed off the Planet, a portable XRD instrument designed primarily for on-location examination of mining and geological samples. The wheeled system is in a ruggedized case and weighs 52 lb (24 kg). The 30 W x-ray tube allows a complete analysis in 15–20 minutes. The system is priced at €70,000–€80,000 (\$79,545–\$90,909 at €0.88 = \$1). Xplorex is a joint venture of **HUBER Diffraktionstechnik**, **Focussing BV** and **AJK Analytical Services**.

Chromatography

Shimadzu previewed its upcoming project, which involves a partnership with the Enabling Technologies Consortium (ETC), to develop a new preparative SFC system with a focused application in the pharmaceutical industry. The system offers high-performance semi-prep purification with faster run times and is a less costly alternative compared to regular prep HPLC in terms of solvent consumption. The prep SFC system also features a gas-liquid separator for a higher recovery ratio and lower carryover compared to earlier SFC systems. This new system is expected to hit the market by summer 2019.

Shimadzu also announced the new Hemp Analyzer, a complete HPLC system dedicated specifically for quantitative determination of cannabinoid content in hemp. Just like the firm's Cannabis Analyzer, this system includes all required hardware, software, consumables and analysis workflow tailored for hemp analysis. This complete system promotes ease of use even for non-chromatographers, while maintaining analytical results.

CRS Scientific brought a lab-scale Fast Protein Liquid Chromatography (FPLC) to Pittcon 2019. The Unique AutoPure FPLC system is specifically designed for protein purification with biocompatible/metal-free components. It offers two different flow rate/pressure specifications: 25 mL/min flow rates for media screening and 100 mL/min

flow rates for larger scale-up operation. The company has been around for 2 years and is mainly based in China, with around 100 units sold in China last year.

Consumables

CEM unveiled Disposable Glass Liners designed for use with CEM MARSXpress Plus vessels in MARS 6 microwave digestion systems. Designed to address the problem of the vessel handling and cleaning bottleneck in microwave digestion systems, these thin-wall glass tube products are designed to be inexpensive, disposable, and eliminate static during the weighing process.

DWK Life Sciences made Pittcon the scene of its debut of the Kimble GLS 80 media bottle and multiport cap system. The focus of the product is as a laboratory-scale bioreactor, with sizes ranging from 250 mL to 20 L. The bottles are composed of inert borosilicate glass and can be clear, amber or provided with a protective coating. The caps allow up to 4 ports to accommodate 5 different tubing sizes.

General Analytical Techniques

Sartorius launched its newest line of balances, the Cubis II, at Pittcon this year. The Cubis II line is completely modular, allowing users to configure the balance to meet their needs and workflows. The balances include features like complete integration with LIMS, motion controls, a static ionizer, and support for 21 CFR part 11 and EU Annex 11 compliance. The Cubis II also includes QApp software that is also configurable to users' needs and comes with future software updates. The Cubis II price ranges from \$4,000 to \$30,000, depending on the configuration.

Lab Automation and Software

ACD/Labs introduced its Katalyst D2D web-based application designed for supporting high-throughput experiments by offering automated planning, execution and analysis. The application features a single interface and integration with third-party systems in order to eliminate manual transcription. Additionally, the Katalyst D2D app enables multi-technique, vendor-agnostic high-throughput analysis utilizing the ACD/Spectrus Platform.

LabVantage Solutions released its LabVantage 8.4 software platform in February, which includes LIMS, ELN and LES capabilities. New and updated features of the edition include a new work assignment and resource planning module, updated data privacy provisions and enhanced data protection, a new Master Data Navigator for enhanced ease of use, bulk data import functionality and automated issue tracking and submission.

Sirius Automation displayed its MiniTasker General Purpose Modular Laboratory Robot Platform which became available last year. The MiniTasker can automate common laboratory tasks such as weighing, sample ID, sorting, dilutions, internal standard addition, standard prep, and capping and uncapping. Additionally, the system features a compact footprint and compatibility with LIMS systems. The MiniTasker is priced at \$40,000-\$50,000.

Lab Equipment

Boekel Scientific displayed two incubators that started shipping over the last few months. The new products, part of the GEN2 series, including a CO₂ incubator for cell culture applications and a Peltier-cooled refrigerated incubator for microbiology. The touchscreen-controlled systems can be programmed for temperature ramps, and have internal electrical outlets that can be controlled by the system to turn shakers or other equipment on and off. The list price on the refrigerated incubator is about \$4,500, while the CO₂ incubator is less than \$6,000.

GATE Scientific introduced the smartSENSE pH. The smartSENSE pH is an upgrade of the current smartSENSE product line, adding a real-time pH measurement feature in addition to temperature and rotational speed measurements. Users can observe the data from their PCs or smartphones through a wireless monitoring and control system. The pH measurement functionality is suitable for fermentation applications in bioprocessing,

pharmaceutical, and the food and beverage industries. The product is currently still in the development stage and will be available for shipment by the end of this year.

Roughly six months ago, **IKA** began shipping its T25 easy clean disperser/homogenizer. The easy-clean feature is due to a unique snap-open design of the disperser element allowing rapid access for cleaning purposes. The unit also features an RPM gauge, temperature monitor and a timer to help scientists adhere to methods. The base unit is priced at about \$2,200 without a dispersing element.

MilliporeSigma showed its next generation Milli-Q IQ series of water purification systems, comprising the 7003, 7005, 7010 and 7015 models (with the last digits referencing the flow rate in liters per hour). Changes over the previous generation include a mercury-free lamp with a longer life and an improved plastic material. The systems have been shipping for about six months, and are priced from approximately \$15,000 to \$20,000, including the installation costs and reservoir.

Life Science

Bioptic showcased the QSep1 portable capillary electrophoresis system, which was first released in the second quarter of 2018. The compact unit utilizes fluorescence detection and has a maximum capacity of eight samples. It currently sells for about \$15,000.

Bioptic also introduced the Qamp Mini PCR thermocycler, which was also first released in the second quarter of last year and costs about \$1,500. The Qamp Mini is a miniature, portable device that can be used in the lab or in the field.

Shimadzu showcased its PPSQ-51A single-reactor protein sequencer and the PPSQ-53A triple-reactor protein sequencer, both of which use an automated Edman degradation reaction method for amino acid sequencing. These systems offer isocratic or gradient separation modes and replace the PPSQ-31A and -33A models, which only offered an isocratic method. These models were first released about six months ago and currently sell for a price between \$100,000 and \$150,000.

Waters introduced the BioAccord LC-TOF MS, a small-footprint system which pairs the ACQUITY UPLC I-Class Plus with the new ACQUITY RDa mass detector. The system is designed with ease of use features, and is optimized for routine QC and late-stage R&D applications in biopharmaceutical labs, initially drug stability testing, glycan analysis and modified peptide monitoring. The ACQUITY RDa detector utilizes SmartMS capabilities, which allow for automated set-up and self-diagnosis. It offers a mass resolution greater than 10,000 FWHM and a mass range up to 7,000 m/z. The system was released in January and sells for approximately \$300,000.

Materials Characterization

Anton Paar showcased its new ViscoQC 100. The ViscoQC 100 is designed to be an intermediate product between complex high-end viscometers and inexpensive viscometers with limited capabilities. This product is available in three version: the L-version for lower-viscosity measurement, such as juice and shower gel; R-version for medium-viscosity products, such a paints and coatings; and H-version for high-viscosity measurements, such as chocolate and balm. Utilizing Anton Paar's Toolmaster system, the spindle for this viscometer is magnetically coupled with no screw required and equipped with a chip to detect which spindle is present (L-, R- or H-version). This instrument also features TruMode measurement, which will automatically set the ideal rotation speed and recommend the most suitable spindle for each sample. Introduced in May 2018, the ViscoQC 100 is available for shipping.

LECO introduced the TGA 801, an automated macro TGA suitable for measuring moisture, ash and volatile content in various industries such as cement and fuels. The TGA 801 is designed to maximize a user's productivity through automated batch analysis with up to 19 samples per cycle. This product features Cornerstone software for instrument control, result analysis, diagnostics and reporting. The software also offers a mobile option which provides access to instrument status and analysis results from smartphone and tablet. TGA 801 was launched in November 2018 and is now available for shipping.

TA Instruments introduced a new addition to its Discovery product line with the TMA 450. This TMA system

features a high resolution, up to 15 nm accurate, dimensional-change measurement and a wide range of temperature condition from -150°C to 1000°C. It also provides a modulated TMA with heating cooling testing-mode interchange. TMA 450 can be applied to research and QC purposes in a wide range of industries such as semiconductor, electronics and aerospace. TMA 450 will be available for shipment starting in the second quarter with a slightly increased price of around 3% compared to previous model.

Molecular Spectroscopy

The Agera color spectrophotometer, set to be released in April, was featured at the **Hunterlab** booth. The Agera will replace the Labscan XE and has new features like an LED light source, a large measurement spot and an integrated 5 MP camera. The Agera can simultaneously measure gloss and reflected color, and includes new software and data management options. The instrument will be priced at about \$20,000.

CRAFT (Complete Reduction to Amplitude-Frequency Table) was showcased by **JEOL** at its press conference. Introduced in November 2018, CRAFT is a software tool for processing NMR data. It forgoes the traditional FT of NMR data and directly analyzes the time-domain NMR data to avoid issues with baseline and phase. CRAFT is integrated into the latest version of JEOL's DELTA NMR software, version 5.3.0.

Pendar Technologies introduced the X10 handheld Raman instrument. The X10 features a noncontact, stand-off design with the ability to analyze unknown substances from a range of 1-3 ft (30-91 cm). Designed for security and safety applications, the X10 offers minimal ignition risk to explosives and an expandable chemical identification library. The price was not disclosed.

Renishaw featured a number of its Raman instruments at Pittcon, including the RA816 Biological Analyzer which was released last November. Following the release of the RA802 Pharmaceutical Analyzer, the RA816 Biological Analyzer is designed exclusively for biological and clinical research. The Bio Analyzer is a compact benchtop Raman imaging system that requires little to no sample preparation, and features easy-to-use hardware and software. Pricing was not disclosed.

Thermo Fisher Scientific introduced the Nicolet Summit FTIR spectrometer at Pittcon, a replacement for the Nicolet iS5. Designed for QA/QC laboratories, the Summit is an entry-level FTIR spectrometer featuring a fully integrated Windows PC and the new OMNIC software.

Thermo Fisher also featured the Nicolet iS20, which was released in November 2018, featuring a redesigned optical system.

Thermo Fisher additionally featured BeerCraft Software, a new software package designed for craft brewers, with the ability to analyze over 20 different attributes of beer. This package is for use with the GENESYS 50 and GENESYS 150 UV/Vis spectrophotometers.

WITec debuted a new particle analysis software tool, ParticleScout, for its alpha300 Raman microscope series at its press conference. It allows researchers to classify, identify and quantify particles quickly and easily. The new tool is designed for a wide range of industries including pharmaceuticals, food, cosmetics and environmental testing. The software locates particles in the field of view and classifies them by various geometric features, such as area and minimum and maximum diameter. Users can configure Boolean operators on these parameters, so that the system will automatically analyze only the particles of interest using the Raman spectrometer to perform chemical analysis for identification.

Surface Science

Bruker presented its JPK NanoWizard ULTRA Speed 2 AFM system, which was released in January. The system is the first new product following Bruker's 2018 acquisition of JPK Instruments (see **IBO 7/15/18**). The NanoWizard ULTRA Speed 2 features advanced bio-imaging capabilities for life science applications, a 10 frames per second scanning speed and atomic resolution.

JEOL introduced its fourth generation benchtop SEM, the NeoScope JCM-7000. The system provides magnification

up to 100,000x, large depth of field, a large sample chamber, and low- and high-vacuum modes. Additionally, the new NeoScope features secondary and backscatter electron detectors, real-time 3D imaging and fully-embedded EDS with real-time “live” analysis capability. The NeoScope JCM-7000 is priced between \$70,000 and \$115,000 depending on options and configuration.

Illustrina Sues BGI in Europe

San Diego, CA 3/29/19—Illustrina has filed suit in Germany against Latvia MGI Tech, a subsidiary of BGI. Illustrina alleges infringement of EP 1 530 578 B1, covering its sequencing-by-synthesis chemistry, by BGI’s sequencers and reagents, such as the BGISeq500 and MGISeq2000. “Illustrina filed this suit to defend the substantial investments we have made in our industry leading sequencing technology, as validated in our global intellectual property portfolio,” stated Charles Dadswell, senior vice president and general counsel for Illustrina. “We will continue to monitor the field and file patent suits where appropriate when our patents are infringed.” In opposition proceedings, the patent’s validity was affirmed by the European Patent Office. In the US, the patent was upheld by the US Patent and Trade Office over challenges filed by BGI and its Complete Genomics subsidiary.

Last year, the USPTO dismissed BGI’s request for an inter partes review of the US patent, 7566537 B2 (“Labelled nucleotides”). This is the same patent that was the subject of Illustrina’s suit against QIAGEN, resulting in an injunction of US sequencer sales (see [IBO 9/15/16](#)). The BGISeq500, launched in 2016, is capable of a read length of 50 base pairs. Launched in 2017, the MGISeq2000 generates paired-end read lengths of 100 base pairs.

Process Water Monitoring Firm Invests in Instrumentation

Fort Collins, CO 3/18/19—In-Situ, a maker of water level, water quality and flow monitoring instruments, has purchased ChemScan for an undisclosed amount. ChemScan, which has changed its name from ASA Analytics, provides automatic chemical analysis systems for water and wastewater monitoring and control. “We’ve made significant investments in new product development and strategic partnerships to improve our capabilities in the process market,” commented In-Situ CEO John Pawlikowski. “With the addition of ChemScan, we have an extremely robust offering to better serve customers in the municipal water, wastewater and industrial markets.”

According to [Fort Collins Coloradoan](#), ChemScan has 20 employees, bringing In-Situ’s workforce to over 180 staff.

Thermo Fisher Scientific Makes \$1.7 Billion Purchase to Grow CDMO Business

Waltham, MA and Cambridge, MA 3/24/19—Thermo Fisher Scientific has agreed to purchase Brammer Bio for \$1.7 billion in cash. Brammer Bio is a viral vector CDMO, serving the gene therapy and gene-modified cell therapy markets. The company is expected to generate 2019 revenues of \$250 million and has over 600 employees. “The combination of Brammer Bio’s viral vector capabilities with our GMP production expertise and proprietary bioprocessing and cell culture technologies uniquely positions us to partner with our customers to drive the evolution of this incredibly fast growing market,” stated Thermo Fisher Scientific President and CEO Marc Casper. In the first full year after purchase, the acquisition is expected to be accretive to adjusted EPS by \$0.10 and close in the second quarter.

Brammer Bio will join Thermo Fisher’s pharma services business, part of the company’s \$10 billion Laboratory Products and Services Segment. [The Wall Street Journal](#) reported that Brammer Bio is owned by Ampersand Capital Partners. Mr. Casper told the newspaper that the companies were already working together and that the CDMO

IBO Stocks Mixed In An Uncertain Market

The US market ended both the month and first quarter with gains, advancing 0.3%. The S&P 500 closed with its best showing since 2009 and its best start to a year since 1998. In addition, March 8 marked the 10th anniversary of the current bull market. Despite the US market ending March on a high note, the state of the economy had a tone of uncertainty throughout the month, with inconsistent behavior throughout the market that could not give investors a clear picture of what was to come for the remainder of the year.

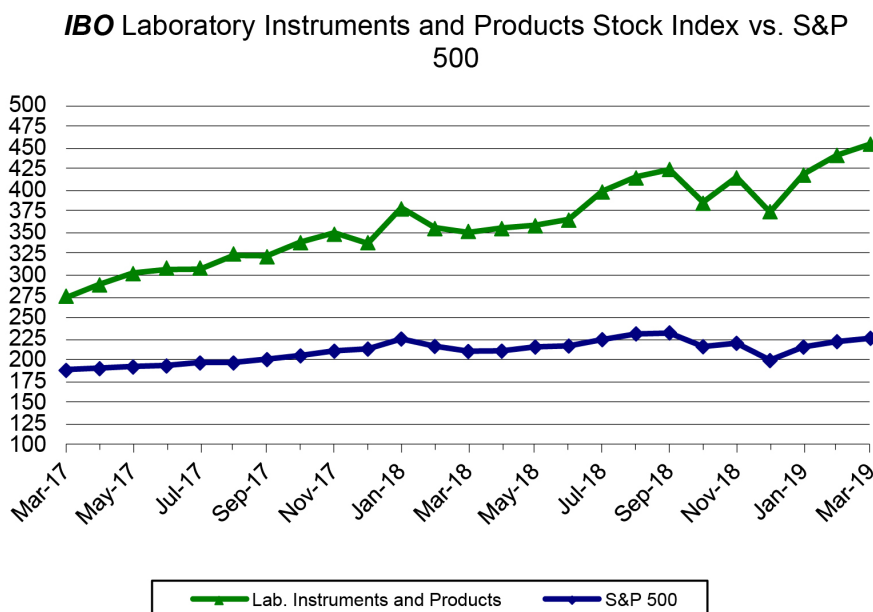
The US-China tariff issue did not reach a conclusion with a trade agreement on March 1 as originally planned. The latest development occurred on March 18, when both parties pushed back their summit meeting to sign a trade agreement to June.

The labor market continued to be a relatively strong economic indicator, yet showed signs of decline. For example, on March 8, the Bureau of Labor Statistics reported that February was the worst month for job creation since September 2017, with only 20,000 jobs created, despite a Dow Jones survey projecting an expectation of 180,000 new jobs. This decline was somewhat offset by increases in wages which rose 3.4%, its strongest pace since April 2019, and the unemployment rate declining to 3.8%.

Another concern investors had was the Federal Reserve's wait-and-see approach to monetary policy. Despite a March 20 announcement that the Fed would hold off on raising interest rate hikes and keep the rates between 2.25%-2.5%, the announcement divided investors who either saw it as a tactic to prolong the current bullish market or a sign that the US economy would continue to slow throughout the year.

The Commerce Department announced on March 28, that the GDP grew 2.2% in the fourth quarter of 2018, a downgrade from the projected 2.6% and the third quarter 2018 figure of 3.4%. Financial analysts attributed the decrease in the GDP due to low spending from consumers, state and local governments and reduced business investment.

For March, the Dow Jones Industrial Average, S&P 500 and NASDAQ all had gains, rising 0.05%, 1.8% and 2.6%, respectively.



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Laboratory Instruments and Products Stock Index

The *Index* advanced 3.0% to \$452.57 this month and is up 21.2% for the year. The *Index*'s performance was mixed, with most companies trading higher this month. The top performing company for the month was **Fluidigm**, which jumped 20.2%. The worst performing company for the month was **Kewaunee Scientific**, declining 12.3%.

In other news, three *Index* companies undertook new securities offerings. **Fluidigm** announced on March 18 a mixed shelf offering of securities to raise an unspecified amount. On March 20, **Quanterix** announced the filing of a prospectus for \$200 million worth of mixed shelf offering of securities. Quanterix did not provide specific share prices for each security being offered. **NanoString Technologies** announced on March 19 the public offering of 4.5 million shares of common stock priced at \$23 per share. The company's stocks slipped 11% on the day of the announcement. The stock offering closed on March 25 with a total of 5.2 million shares of common stock sold, resulting in \$68.3 million of net proceeds.

In addition, **BioNano Genomics** entered into financing agreements on March 14 totaling \$41.5 million in debt and equity commitments from affiliates of Innovatus Capital Partners, East West Bank and Aspire Capital Fund.

On March 11, **Kewaunee Scientific**'s stock slipped 6% after the announcement of David Rausch' resignation as the president, CEO and director. Thomas D. Hull, who served as CFO since 2015, has been appointed as his successor.

In rating news, on March 1, Deutsche Bank gave **Bio-Rad Laboratories** a "buy" rating and raised its price target from \$330 to \$350, a 9.1% upside from the March 1 price of \$320.92. On the same day, Barclays gave the company an "overweight" rating and raised its price target from \$315 to \$340, a 5.9% upside from the March 1 price of \$320.92.

Thermo Fisher Scientific had various rating news throughout the month. On March 18, Barclays gave the company an "overweight" rating and raised its price target from \$295 to \$300, a 14.5% increase compared to its March 18 price of \$261.97. On March 22, Deutsche Bank gave Thermo Fisher a "buy" rating and raised its price target from \$275 to \$300, up 12.9% March 22 price of \$265.63. Lastly, on March 25, UBS Group gave the company a "buy" rating and raised the price target to \$305, a 14.2% upside from the March 25 price of \$267.05.

On March 26, Cowen gave **Agilent Technologies** an "outperform" rating and raised its price target from \$80 to \$90, up 11.6% the March 26 price of \$80.63.

Although they reported financial results this month, the following companies did not provide EPS guidance: **BioNano Genomics**, **NanoString Technologies** and **Quanterix**.

Company	Date Rep.	Fiscal Quarter	2018 Adj. EPS	Analyst Consensus	Vs. Estimate	YOY Growth	2017 Adj. EPS
Laboratory Instruments and Products Stock Index							
BNGO	14-Mar	Q4	(\$0.62)	(\$0.48)	↓ -\$0.14	NA	NA
BNGO	14-Mar	FYE	(\$2.61)	NA	NA	-69.8%	(\$8.65)
NSTG	7-Mar	Q4	(\$0.68)	(\$0.51)	↓ -\$0.17	100.0%	(\$0.34)
NSTG	7-Mar	FYE	(\$2.78)	NA	NA	51.1%	(\$1.84)
QTRX	7-Mar	Q4	(\$0.42)	(\$0.25)	↓ -\$0.17	-60.4%	(\$1.06)
QTRX	7-Mar	FYE	(\$1.43)	NA	NA	-82.8%	(\$8.30)

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Diversified Laboratory Index

In March, the *Index* increased 2.5% to \$257.31 and is up 3.3% for the year. All companies in the *Index* except **Corning** and **Illinois Tool Works** experienced monthly gains. Corning and Illinois Tool Works declined 4.9% and 0.4%, respectively. **Roper Technologies** experienced the highest gains in share price, rising 5.7%, while **Teledyne Technologies** experienced the smallest, rising only 0.4%.

On March 1, **Danaher** announced the closing of the concurrent offerings of its 12.1 million common stock offering at the price of \$123.00 per share and its 1.65 million shares of 4.75% Series A Mandatory Convertible Preferred Stock at the price of \$1,000 per share. The net proceeds were approximately \$1.44 billion and \$1.60 billion, respectively. Danaher will use the proceeds to fund a portion of the pending acquisition of the Biopharma business of **GE Life Sciences** (See [IBO 2/28/19](#)). On March 8, Danaher declared a \$0.17 dividend, a 6.3% increase from the prior dividend of \$0.16.

International Stocks

For the month, the Asia Pacific markets were mixed with three indexes having positive gains and the remaining three indexes experiencing declines. India's Sensex experienced the largest gain, rising 7.23%, while Japan's Nikkei 225 was one of region's worst performing indexes, sliding 1.84%.

Prices for the Asia Pacific region companies in the *IBO* Stock Table were mixed, with most companies experiencing monthly gains. **Shimadzu** was the only company to rise in the double digits, increasing 16.8%. The two companies with monthly declines were **GL Sciences** and **Yunnan Energy**, decreasing 1.1% and 18.7%, respectively.

European equity markets were mostly positive in March. Italy's FTSE MIB Index and London's FTSE 100 expanded 2.86% and 2.43%, respectively. Germany's DAX and Spain's IBEX 35 experienced monthly declines, sliding 0.65% and 0.30%, respectively.

Prices for the European stocks in the *IBO* Stock Table were mixed in March with 6 companies showing gains and 6 experiencing monthly declines. **Scientific Digital Imaging**, **Merck KGaA** and **Sartorius** were the only companies to grow in the double digits, increasing 11.2%, 11.5% and 10.9%, respectively. In contrast, **Expedeon** and **Abcam** were the biggest losers, declining 10.7% and 11.7%, respectively.

Abcam reported its first-half financial results on March 4. Adjusted diluted EPS increased 5.2% to 16.3 pence (\$0.21) as the company continued to show broad-based demand across all product categories. **Merck KGaA** announced both fourth quarter 2018 and full-year 2018 results on March 7, posting a fourth quarter adjusted EPS increase of 141.6% to €5.63 (\$6.39) and a full-year adjusted EPS rise of 29.5% to €7.76 (\$9.12). **Tecan** reported full-year 2018 results on March 11. Diluted EPS increased by 6.6% to CHF 5.96 (\$6.08) as the company posted high-single-digit revenues (see [Bottom Line](#)).

In ratings news, on March 22, Deutsche Bank reaffirmed **Halma's** "buy" rating while, on the same day, UBS Group reaffirmed its "sell" rating of the same company. Also, Goldman Sachs Group downgraded **Spectris** to a "sell" rating and lowered the price target from 2,600 pence (\$33.97) to 2,200 pence (\$28.75).

Company: Exchange	Market Value (US M)	52-Week Range		Price 3/31/2019	Change 1 Month	Change YTD	P/E (ttm)	EPS (ttm)
		Low (\$)	High (\$)					
Laboratory Instruments and Products								
Agilent Technologies: n	\$25,604	60.42	82.27	\$80.38	1.2%	19.2%	29	2.79
Becton, Dickinson and Company: n	\$66,992	208.62	265.87	\$249.73	0.4%	10.8%	22	11.19
BioNano Genomics: o	\$44	3.50	10.00	\$4.36	9.8%	-16.8%	NM	-2.61
Bio-Rad Laboratories: n	\$7,599	220.05	345.15	\$305.68	12.8%	31.6%	52	5.85
Bio-Techne: o	\$7,498	132.75	206.04	\$198.55	2.4%	37.2%	43	4.59
Bruker: o	\$6,166	26.10	40.25	\$38.44	0.6%	29.1%	27	1.40
Fluidigm: o	\$647	4.65	14.90	\$13.29	20.2%	54.2%	NM	-1.02
Illumina: o	\$45,671	225.82	372.61	\$310.69	-0.7%	3.6%	54	5.72
Kewaunee Scientific: o	\$58	20.21	38.80	\$21.06	-12.3%	-36.6%	17	1.22
Luminex: o	\$1,026	19.20	35.37	\$23.01	-9.7%	-0.4%	47	0.49
Mettler-Toledo: n	\$18,108	500.74	732.46	\$723.00	6.2%	27.8%	36	20.36
MTS Systems: o	\$974	38.42	57.00	\$54.46	2.2%	35.7%	25	2.14
NanoString Technologies: o	\$738	7.11	31.14	\$23.93	-6.0%	61.4%	NM	-2.79
Pacific Biosciences: o	\$1,077	2.02	7.84	\$7.23	-1.1%	-2.3%	NM	-0.77
PerkinElmer: n	\$10,719	70.83	98.33	\$96.36	2.3%	22.7%	27	3.62
QIAGEN: o	\$9,216	0.00	40.43	\$40.68	5.9%	18.1%	30	1.34
Quanterix: o	\$418	13.00	26.06	\$25.83	4.5%	41.1%	NM	-8.30
Thermo Fisher Scientific: n	\$110,193	199.85	273.94	\$273.72	5.5%	22.3%	25	11.12
Twist Bioscience: o	\$648	12.38	34.46	\$23.18	6.5%	0.4%	NM	-7.77
Waters: n	\$19,066	167.94	252.24	\$251.71	3.9%	33.4%	30	8.33
Diversified Laboratory								
AMETEK: n	\$19,259	63.14	83.12	\$82.97	4.3%	22.6%	27	3.13
Corning: o	\$26,493	26.11	36.56	\$33.10	-4.9%	9.6%	18	1.79
Danaher: n	\$92,533	94.59	132.60	\$132.02	3.9%	28.0%	29	4.52
Honeywell: n	\$117,647	123.48	162.52	\$158.92	3.1%	20.3%	20	8.01
Illinois Tool Works: n	\$47,623	117.75	160.21	\$143.53	-0.4%	13.3%	19	7.60
Roper Technologies: n	\$35,341	245.59	342.57	\$341.97	5.7%	28.3%	29	11.81
Teledyne Technologies: n	\$8,551	177.68	250.87	\$237.01	0.4%	14.5%	26	9.01
Xylem: n	\$14,205	60.65	82.44	\$79.04	4.6%	18.5%	28	2.84
Laboratory Instruments and Products				\$452.57	3.0%	21.2%	33	
Diversified Laboratory				\$257.31	2.5%	3.3%	25	
Dow Jones Industrial Average				\$25,928.68	0.05%	11.2%		
S&P 500				\$2,834.40	1.8%	13.1%		
NASDAQ Composite				\$7,729.32	2.6%	16.5%		
Region	Market Value	52-Week Range		Price	Change	Change	P/E	EPS
Company	(Local M)	Low (L)	High (L)	3/31/2019	1 Month	YTD	(ttm)	(ttm)
Pacific Shares								
GL Sciences: t	¥17,356	¥1,170	¥19,990	¥1,551	-1.1%	20.5%	11	¥144.70
Hitachi High-Technologies: t	¥628,094	¥3,130	¥5,300	¥4,560	7.7%	32.0%	17	¥264.65
HORIBA: t	¥259,008	¥4,155	¥9,590	¥6,090	8.0%	35.6%	12	¥526.98
JEOL: t	¥98,062	¥1,493	¥2,595	¥2,007	9.9%	21.1%	70	¥28.59
Precision System Science: os	¥10,504	¥236	¥679	¥419	8.5%	56.3%	NA	¥0.40
Shimadzu: t	¥948,904	¥2,008	¥3,670	¥3,205	16.8%	47.4%	30	¥106.20
Yunnan Energy: hk	HKD 636	HKD 1.9	HKD 5.2	HKD 2	-18.7%	-32.1%	NM	(\$0.49)
European Shares (London)								
Abcam: l	£2,332	£10.06	£15.88	£11.35	-11.7%	4.1%	70	£0.16
Halma: l	£6,348	£11.42	£17.07	£16.72	7.6%	22.6%	71	£0.24
Horizon Discovery: l	£224	£1.28	£2.52	£1.49	2.8%	-14.9%	NA	-£0.05
Oxford Instruments: l	£561	£7.40	£11.16	£9.77	-3.3%	7.4%	36	£0.27
Scientific Digital Imaging: l	£42	£0.12	£0.52	£0.47	11.2%	34.3%	43	£0.01
Spectris: l	£2,900	£19.25	£29.57	£25.10	-4.9%	10.1%	15	£1.65
European Shares (Other)								
Biotage: st	SEK 7,720	SEK 68.40	SEK 145.00	SEK 118.40	-6.2%	8.6%	46	SEK 2.58
Datacolor: s	CHF 114	CHF 680.00	CHF 900.00	CHF 680.00	-3.5%	-8.1%	28	CHF 24.48
Expedeon: g	€ 46	€ 0.70	€ 1.40	€ 0.90	-10.7%	-0.2%	NM	€ 0.00
Merck KGaA: g	€ 13,060	€ 77.16	€ 101.05	€ 101.05	11.5%	12.6%	13	€ 7.76
Sartorius: g	€ 5,129	€ 90.40	€ 140.50	€ 137.00	10.9%	42.7%	22	€ 6.10
Tecan: s	CHF 2,764	CHF 179.30	CHF 256.00	CHF 234.80	3.7%	23.1%	39	CHF 5.96

The *I/O* Stock Indexes are weighted by marked capitalization. The Indexes' averages for the financial ratios presented are also weighted statistically to reflect the relative sizes of the constituent companies. Laboratory Instruments and Products Index : 12/30/11 = 100. Diversified Laboratory Index : 12/30/11 = 100. Exchanges: n = NYSE; o = NASDAQ; t = Tokyo; hk = Hong Kong; l = London; g = Germany; s = Switzerland; st = Sweden; no = Nordic Market; os = Osaka Securities. N/A = not available; NM = not meaningful.

Note: Losses are excluded from P/E ratio calculation of each index group.

illumina 2018 Service Revenues

In the February 15 issue of *IBO*, illumina's 2018 service revenue figure was incorrect. The table below shows the results as reported by the company. The original website article has been updated.

illumina FYE 18			
	Chg.	Rev. (M)	% of Rev.
Consumables	23.0%	\$2,156	65%
Instrument	10.5%	\$569	17%
Other Products	14.3%	\$24	1%
Service & Other	26.1%	\$584	18%

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Digital Microfluidics

Digital microfluidics (DMF) is a transformative fluid handling technology based on the precise manipulation of very low-volume (typically nanoliter-scale droplets) liquid samples. DMF-based technology enables increased automation and precision of common laboratory liquid handling operations such as dispensing, transfer, storage and analysis by utilizing miniaturized substrates or chips. DMF can be used to enhance or automate analytical techniques such as NGS library preparation, immunoassays, MS, NMR spectroscopy, chemical synthesis, and separation and extraction procedures.

Analogous to digital microelectronics, digital microfluidic functions can be combined and reused within hierarchical design structures to execute complex procedures, such as chemical synthesis or bioassays, built up in step-by-step sequences. Furthermore, in contrast to traditional continuous-flow microfluidics, digital microfluidics works much the same way as traditional benchtop protocols, only with much smaller volumes and much greater automation. This enables a wide range of established chemical procedures and protocols that can be seamlessly transferred to a nanoliter droplet DMF configuration. Several advantages are associated with DMF platforms including low-volume liquid sample requirements, increased sensitivity, greater throughput, decreased cost and less procedural variation.

DMF technology is used to manipulate droplet-sized liquid volumes on a substrate or chip. While a variety of principles of operation exist, the most common methods utilize electrowetting in order to alter the surface energy of specific regions of the underlying substrate, thereby manipulating whether the liquid adheres to (wets) or is repelled by (forms droplets) the surface. This mechanism allows very small nanoliter droplet-sized samples to be controlled and moved across different areas of the substrate. By programming specific and increasingly complex steps for the sample, complicated laboratory procedures can be greatly scaled down and automated.

A number of applications currently use DMF, while numerous others are currently being researched and developed. Life sciences and biopharmaceutical end-users provide the most demand for DMF technology due to the value of high-throughput automation and variation reduction to these labs. illumina is currently a leading vendor in DMF technology following its acquisition of digital microfluidics technology company, Advanced Liquid Logic (see [IBO 7/31/13](#)). illumina's NeoPrep Library Prep System utilizes DMF technology in order to automate library preparation for NGS applications. The NeoPrep reduces hands-on time in the lab and uses consumables called library cards as the microfluidic substrate, which plug into the NeoPrep instrument for control and analysis.

Additionally, DMF is being coupled with MS in order to provide either indirect off-line, direct off-line or in-line

analysis in order to reduce solvent and reagent use, and analysis time. Similarly, DMF-based technology is also being integrated with NMR techniques in order to limit waste and prevent cross contamination. Immunoassays are another area where DMF platforms are finding an increasing number of applications. ELISA-on-a-chip platforms are promising for point-of-care and other applications, which can be conducted outside of traditional laboratory settings such as testing environmental or clinical samples in the field.

Digital Microfluidics at a Glance:

Leading vendors

- Illumina
- PerkinElmer
- Fluidigm

Largest markets

- Pharmaceutical and Biotechnology
- Academia
- Hospital and Clinical

Price range

- \$5,000-\$100,000

Energy

According to the International Energy Agency (IEA), the US is forecast to double gross crude oil exports to 4.2 million barrels per day (b/d) by 2024, as total crude and refined products will reach 9 million b/d. Based on these figures, the US is likely to become a net petroleum exporter by 2021, surpassing Russia and Saudi Arabia, which is currently the largest oil exporter in the world, soon after.

Driven by shale oil growth, US crude production is predicted to comprise 70% of the rise in the world's production capacity over the next five years, and will represent 75% of the growth in liquefied gas. The US surpassed Russia and Saudi Arabia last year in crude oil production, with current output at approximately 12 million b/d. By the end of the IEA's five-year forecast, US crude production is forecast to grow to 13.7 million b/d.

The Organization of the Petroleum Exporting Countries' (OPEC) production capacity has been affected by supply outages in Iran and Venezuela, resulting in output expected to decrease by 400,000 b/d up to 2024. OPEC decided to restrict crude output by a cumulative 1.2 million b/d for the first 6 months of 2019 in order to bring back balance to the oversupplied market, as the surplus led to oil prices plummeting approximately 40% in the fourth quarter 2018. Thanks to the cuts, oil prices have grown nearly 20% since the beginning of the year. The IEA forecasts that oil demand will increase at an average annual rate of 1.2 million b/d up to 2024, reaching 106.4 million b/d, a 7.3% rise from 2018.

Source: [The Wall Street Journal](#)

Clinical

In just a few years, liquid biopsy has been adopted as an efficient assay for cancer testing. The test is simple to conduct and has a quick turnaround time, and can work for both solid and hematological tumors. Additionally, liquid biopsies work across multiple specimen types, and can be used to identify the molecular profiles, tumor evolutions

and resistance mechanisms of patients.

In 2016, the FDA approved the first liquid biopsy test for epidermal growth factor receptors, or EGF. With new and enhanced technologies continuing to be developed, demand is forecast to keep on a steady rise.

Digital PCR (dPCR) is a complementary technology to liquid biopsy, especially for assessing circulating tumor DNA (ctDNA) due to its high sensitivity. dPCR is also cost effective and does not require the need of specialized bioinformatics like NGS. It also offers superior precision compared to PCR, as the test consists of up to millions of independent PCR reactions in separate microdroplet-based compartments. In dividing the sample into so many droplets, there is a low chance that more than one DNA molecule will be amplified in an individual droplet, making the assay exact, extremely reproducible and quantitative.

Cell-free DNA testing is also key, as it is used as a screening test when it is suspected that a patient has secondary resistance to EGFR tyrosine kinase inhibitors. When a test result is negative, a biopsy is scheduled for the patient. As it can be difficult to assess the level of cell-free DNA in a liquid biopsy sample unless the result is positive, this can lead to false-negative results of liquid biopsies. To address this, many institutions are currently or planning to develop their own cell-free DNA assays, indicating that the growth of liquid biopsy tests will not be slowing down soon.

Source: [CAP Today](#)

Pharmaceuticals

Many pharmaceutical companies have failed to create therapies to treat Alzheimer's disease by targeting a brain compound called beta amyloid. After spending hundreds of millions of dollars over a few years on clinical trials for safety and efficacy, companies are discontinuing effort, not due to safety concerns but a lack of efficacy. In total, approximately 200 failed attempts to develop a treatment for Alzheimer's have been recorded.

A protein in the brain, beta amyloid collects into clumps of plaque in the brains of Alzheimer's patients. Traditionally, drug manufacturers have attempted to clear beta amyloid with treatments. However, it is unclear if the clumped beta amyloid is a cause of Alzheimer's or an end result of damage already caused by the disease. Companies such as Merck, Eli Lilly and Pfizer have all discontinued large-scale trials focusing on beta amyloid, and while much hope was placed on recent efforts by companies such as Biogen, those endeavors have also failed. Biogen's discontinuation is the second failure this year, following Roche's conclusion in January that its own two large studies were likely to fail.

According to researchers, it is becoming harder to justify why beta amyloid treatments are not effective. They believe that because the medical community is so focused on beta amyloid, it is negatively affecting the consideration of other potential treatments and research. Although some Alzheimer's patients have genetic mutations related to beta amyloid production, a direct causal relationship between the two has yet to be established.

Source: [Bloomberg](#)

EU

EU institutions have given the greenlight for Horizon Europe, an initiative proposed by the European Commission last June as a part of the EU budget for 2021-27. Touted as the most ambitious research and innovation program in the world, Horizon Europe is designed to ensure Europe's position as a global leader of innovation and R&D.

Building on Horizon 2020, Horizon Europe will similarly function through the European Research Council (ERC) and will utilize the technical support and research of the Joint Research Center, which is the Commission's science and knowledge service. As a new feature, Horizon Europe will include the European Innovation Council (EIC), which is currently in a pilot phase. The EIC will aid in bringing cutting edge innovations in technology from the lab to market

applications, as well as support startups and small- and medium-sized enterprises scale-up their operations. Two main funding instruments will be provided by the EIC, one for early stage innovation and the other for development and market deployment, working alongside the European Institute of Innovation and Technology.

The implementation of Horizon 2020 has been approved by the European Parliament, ERC and European Commission, but is subject to approval by the European Parliament.

Source: [European Commission](#)

China

Materials science funding in China has quadrupled since 2008, with the number of Chinese publications on materials science growing accordingly, tripling between 2006 and 2017 to 40,000. In 2015, for example, approximately 1 in every 9 scientific papers published by Chinese scientists was about materials science.

In 2016, the government established the Materials Genome Engineering (MGE) initiative, aiming to accelerate Chinese innovation of new materials. Two key goals of the MGE is to create a centralized software platform that provides data mining and instant feedback capabilities to companies on how materials work, as well as the production of enhanced materials that are manufactured rapidly and are cost effective.

In addition, materials science receives the second-highest level of funding from the National Natural Science Foundation of China (NNSFC), following medical sciences. This is part of the government's plan to drive innovation to new levels by 2020, which includes research projects such as exploring the moon and creating the first Chinese-designed passenger aircraft.

Last year, the NNSFC funded 701 projects with over CNY 2 billion (\$297.9 million), including the MGE, nanotechnology and advanced electronic materials projects. Currently, China publishes the greatest number of high-impact research papers in the world in 23 fields, such as batteries, semiconductors, new materials and biotech.

Source: [Nature](#)

UK

R&D expenditures in the UK grew 4.8% in 2017 to £34.8 billion (\$45.9 billion), 7 basis points above the average annual increase of 4.1% since 1990. This figure represented 1.69% of the UK's GDP, up 2 percentage points from 2016, but still below the EU's provisional estimate of 2.07%.

The business sector spent £23.7 billion (\$31.3 billion) on R&D in 2017, a 4.9% increase, and represented 68% of total UK R&D expenditures. The pharmaceutical product group within the business sector had the highest R&D expenditures in 2017 at £4.3 billion (\$5.7 billion). The "miscellaneous business activities," technical testing and analysis product groups spent £1.5 billion (\$2.0 billion) on R&D, while £1.4 billion (\$1.8 billion) was spent on software development R&D.

Accounting for 23% of total UK R&D expenditures in 2017, the higher education sector spent £8.2 billion on R&D. The higher education sector had the fastest growth increase, rising 5.6%. London was the main R&D region in 2017, with the city spending £2.0 billion (\$2.6 billion), representing 36% of the region's total R&D expenditures.

Government R&D expenditures grew 1.1% to £2.2 billion (\$2.9 billion), and the sector accounted for 6% of total R&D expenditures in 2017. Research Councils UK, a strategic partnership between seven UK research councils, spent £866 million (\$1.1 billion) on R&D in 2017, a 3.5% increase.

The smallest R&D performing segment, the private nonprofit sector, increased R&D spending 4.4% in 2017 to £800 million (\$1.1 billion). This sector accounted for 2% of total UK R&D expenditures.

Broad-based Companies

Company Announcements

Clustermarket, an online equipment sharing and booking platform, announced in December 2018 an agreement with **GE Healthcare Life Sciences** for sourcing.

In February, **Olympus** launched the Olympus Industrial Research Chair on Ultrasonic Nondestructive Testing with the Quebec engineering school **École de technologie supérieure**. The five-year partnership will focus on nondestructive testing, including simplifying the interpretation of data obtained through ultrasonic testing, designing novel ultrasonic transducers for harsh environments and engineering innovative ways to test materials without causing damage or disassembling them.

In March, **Roper Technologies** announced a realignment of its reportable segments. The four new segments are: Application Software; Network Software & Systems; Measurement and Analytical Solutions, which includes **Gatan** and **Struers**; and Process Technologies, including **PAC**.

As part of their ongoing collaboration, **Agilent Technologies** and **Imperial College London** installed the Agilent Measurement Suite at the Molecular Sciences Research Hub in March.

In March, **Endress+Hauser** announced a \$38.5 million investment in a 112,000 ft² (34,137 m²) Gulf Coast Regional Campus in Pearland, Texas. The facility will house teams to support **Endress+Hauser**, **SpectraSensors** and **Analytik Jena**. The campus will also have a building and warehouse location for Endress+Hauser's partner for sales and service in the Gulf Region, **Vector Controls** and **Automation Group**. The project is expected to be completed by the end of 2020.

In March, **FOSS** reported that 2018 revenues increased 0.8%, 4.3% organically, to DKK 2.243 million (\$354.9 million) (see [Bottom Line](#)).

Unity Scientific announced in March a name change to **KPM Analytics North America**.

In March, chemistry automation firm **Skalar** opened an office in Lisbon, Portugal.

Life Science Consumables

Company Announcements

Dr. Cristina Garmendia Mendizábal, chairwoman of **Expedeon**'s supervisory board, will step down, effective April 4. Joseph Fernandez, deputy chairman of the board, will assume Dr. Garmendia's responsibilities until a suitable successor is found.

In March, **JSR** announced it will establish a US business under the name **JSR Life Sciences**, effective April 1. JSR Life Sciences will also be a subsidiary of the new **JSR North America**.

ATCC, a provider of biological materials and information, announced in March a strategic partnership with R&D services management firm **Science Exchange**. ATCC's services featured on the Science Exchange Marketplace will include offerings from custom solutions, such as the expansion and characterization of cells and microorganisms, custom genome editing, cell line authentication and other solutions. This agreement marks the first time that ATCC is offering its services through a third-party e-commerce platform.

Science Exchange and **WuXi LabNetwork**, a chemistry e-commerce platform, entered into a technology

partnership in March that will allow Science Exchange users to directly order compounds from WuXi LabNetwork via a single user interface.

In March, **Diagenode**, a provider for complete solutions for sample preparation and epigenetics research, entered into an informal distribution relationship with **Cedarlane** to promote and distribute a larger range of Diagenode products in Canada.

Gene-based Analysis

Company Announcements

Synthetic DNA firm **Twist Biosciences'** fiscal 2018 sales for the year ending September 30, 2018 increased 135.2% to \$25.4 million (see [IBO 2/15/19](#)). By product line, sales of synthetic genes, oligo pools and DNA libraries grew 121.4%, 46.0% and 242.6% to make up 71%, 12% and 7% of sales. Sales of NGS tools totaled \$2.7 million. The company had 719 customers, with sales to the industrial chemicals, academic research, agricultural and healthcare sectors accounting for 59%, 23%, 2% and 16% of total sales. Sales to **Ginkgo Bioworks** represented 34% of revenues sales, up 101%. Twist Bioscience revenues this year are expected to total \$46-\$48 million.

In February, **Integrated DNA Technologies (IDT)** announced the expansion of its courier zones, including free next day delivery, for oligonucleotides to UK scientists based in Cambridge, Oxford and London, both inside and out of the M25 orbital motorway.

In March, CRO **Aldevron** released the GMP Spy Fi Cas9 Nuclease for clinical and commercial applications. Spy Fi Cas9 Nuclease, the trade name for Aldevron's research-grade and GMP products, is the direct result of a partnership with **Integrated DNA Technologies (IDT)**.

Merck KGaA received a formal notice from the **US Patent and Trademark Office** in February allowing Merck's patent application directed to its proxy CRISPR technology, its first US patent for CRISPR and 13th such patent worldwide.

In March, **Merck KGaA** announced that the **Canadian Patent Office** has allowed its patent application directed to the use of paired CRISPR nickases in eukaryotic cells. This is Merck's second CRISPR patent in the country.

In February, **Cell Mogrify** announced a second close on its seed funding, bringing the total raised to \$3.7 million, and appointed Darrin M Disley, PhD, DSc, OBE, as CEO. The company will use the funding to market novel intellectual property and cell types generated using its proprietary direct cellular conversion platform for the development and manufacture of cell therapies.

Phase Genomics, a supplier of proximity ligation-based genomic solutions, received in February a year-long grant from the **Bill & Melinda Gates Foundation** to develop an improved computational method for extracting genomic information from complex microbiome samples. The new tool will help researchers discover new microbes and understand how microbial strains are passed between mothers and infants.

Product Introductions

In January, **Twist Bioscience** expanded its product portfolio to offer genes up to 5 kb in length at a price of \$0.15 per base pair with a turnaround time between 15 and 25 days. Twist Bioscience is also making its Application Programming Interface (Twist API or TAPI) available to all customers ordering genes.

ArcticZymes launched in March the T4 DNA Ligase. T4 DNA Ligase catalyzes the formation of phosphodiester bonds between juxtaposed 5' phosphate and 3' hydroxyl termini in duplex DNA or RNA.

Cell-based Analysis

Company Announcements

In February, **Lonza** and **AllCells** entered into a private label partnership for the manufacture and commercialization of an extensive range of hematopoietic primary cells. Under the new agreement, the entire AllCells research portfolio of products will bear the Lonza branding.

Stem cell research company **REPROCELL** signed a non-exclusive distributorship agreement in February with **RUITAI Biotechnology (Shanghai)** for China.

In February, **Transomic Technologies** placed its CRISPR whole-genome arrayed library at **McGill University**, supported by the **Rosalind and Morris Goodman Cancer Research Centre**.

RoosterBio which supplies off-the-shelf cell banks and bioprocess media products, announced in February a planned expansion in Frederick, Maryland, with 14,000 ft² (4,267 m²) designed to accommodate scale up of mesenchymal cell manufacturing and R&D. In January, the company grew to more than 40 employees and plans to double again in the next 18-24 months. RoosterBio serves more than 200 customers in 18 countries.

In February, **StemoniX**, maker of the microOrgan platform, secured \$14.4 million in Series B funding, led by **Brightstone**.

In March, **Beam Therapeutics**, a developer of next generation CRISPR technologies, completed a \$135 million Series B financing.

Product Introductions

Cell culture media manufacturer **FUJIFILM Irvine Scientific** introduced in March the IS Sf Insect medium, formulated for scalability for the consistent growth and yields of proteins, viral vectors and viral-like particles using baculovirus expression systems, in Sf9 and Sf21 cells.

In March, **Miltenyi Biotec** debuted the REAlease Releasable Antibodies based on the REAlease Fluorochrome Technology that allows for the removal of antibodies after cell sorting in just one step. Sorted cells are label free.

Hello Bio launched in March the water-soluble and highly potent hM3Dq and hM4Di ligands studying GPCR and DREADD (designer receptor exclusively activated by designer drugs) signaling. Hello Bio was granted a license from the **National Institute on Drug Abuse** and the **National Institute of Neurological Disorders and Stroke**, both institutes of the **NIH**, as well as **Johns Hopkins University** to make the products commercially available.

In March, **Promega** released a new Water-Glo System for monitoring microbial contamination in freshwater, process water, seawater or wastewater samples using bioluminescent technology to measure adenosine triphosphate. The reagent is stable for 6 months at 4°C or 2 weeks at room temperature, and can measure up to 96 samples at once using the large-format option.

Protein Based Analysis

Company Announcements

In January, AI firm **Bioz** partnered with **RayBiotech**, a provider of planar cytokines. **Bioz** enables access real-world validated use cases coming directly from scientific articles.

In February, **ABclonal Technology**, a provider of biology research reagents and services, and **BenchSci**, a life science machine learning company, entered into a partnership. Using machine learning, BenchSci will identify published data for ABclonal's products in open- and closed-access research papers, and display vendor-provided validation figures to allow scientists to find the right antibody that fits their experimental context, irrespective of the number of citations.

Cellaria, which develops new models for cancer and other diseases, named **Rockland Immunochemicals**, a life

science supplier and manufacturer that specializes in antibodies and antibody-based tools for research applications and assay development, a distributor of its in vitro disease models and cell culture media.

In February, **Abcam** announced its move to new global headquarters, Discovery Drive, on the Cambridge Biomedical Campus, UK.

Abcam and CRO **Visikol** announced a collaboration in March to develop new reagents and kits for improved tissue clearing and 3D imaging.

In March, **Sona Nanotech**, which manufactures rod-shaped gold nanoparticles, announced a collaboration with diagnostics solutions provider **Romer Labs** to improve the performance in Romer Labs' lateral flow assay-based RapidChek SELECT pathogen test kits.

Product Introductions

In February, **Bio-Rad Laboratories** released a range of recombinant monoclonal anti-idiotypic antibodies that inhibit the binding of eculizumab (Soliris) to its target, complement C5 protein.

In March, **CDI Laboratories** announced that ~2,000 new recombinant proteins have been added to its HuProt human proteome microarray. The HuProt v4.0 array now contains over 21,000 human proteins and protein isoforms.

Neogen introduced in March the sandwich ELISA-based Reveal 3-D for Coconut Allergen, which screens environmental and liquid samples at 1 ppm in only 5 minutes, providing results in the range of 1-25 ppm for testing food and beverage samples.

Sales and Orders of Note

IMMUNOPRECISE ANTIBODIES (IPA) announced in February a five-year Indefinite Delivery/Indefinite Quantity subcontract from **Leidos Biomedical Research**, which currently operates the **Frederick National Laboratory for Cancer Research for the National Cancer Institute**. Under the subcontract, IPA will discover and produce rabbit monoclonal antibodies using its proprietary B-Cell Select platform. The rabbit monoclonal antibodies will be used in the key applications of immunohistochemistry and immuno-Multiple Reaction Monitoring.

GC & GC/MS

Company Announcements

In March, **LECO** and **Restek** announced an expanded collaboration, allowing LECO customers access to a core set of Restek consumables for GCxGC.

INFICON 2018 Security & Energy sales rose 13.7% to \$29.0 million, or 7% of company revenues. The segment expects 2019 results to be below average.

Product Introductions

LECO introduced in January a new FLUX flow modulator option for routine GCxGC, making GCxGC more accessible and easy to use. The cost effective modulator does not require cryogenics.

In February, **Agilent Technologies** debuted the Agilent 8890 and 8860 GC systems, built on a next generation electronic architecture platform and featuring continuous system monitoring, automated diagnostics and built-in troubleshooting routines, as well as remote connectivity. The company also released two complementary Blank and

Detector Evaluation smart routines, which are also available for the Intuvo 9000 GC.

In March, **JEOL** announced the development of the msFINE Analysis software packages for qualitative GC/MS using the AccuTOF-GCx PLUS MS. The software integrates the information from multiple ionization techniques with database search, exact mass and isotope data.

Bioprocess Analysis

Company Announcements

In February, **Thermo Fisher Scientific** announced an agreement to supply nucleotides, enzymes and other critical raw materials to support **BioNTech**'s mRNA manufacturing platform. The four-year, nonexclusive licensing and supply agreement gives BioNTech rights to use Thermo Fisher's technologies as part of its clinical and commercial manufacturing processes.

In March, **Pall**, a **Danaher** company, partnered with **Broadley-James** to integrate and distribute Broadley-James' single-use probe and flow cell pH sensors for applications across upstream and downstream unit operations. The sensor will be integrated into Pall Biotech's single-use technologies, as well as other commercially available bioprocessing platforms. Broadley-James single-use probe and flow cell pH sensors are currently in beta testing and when launched will be available exclusively through Pall Biotech.

Pall announced in March the next step in its collaboration agreement with **ARTeSYN Biosolutions**, a supplier of single-use components and fluid management technologies. Under the co-exclusive agreement, Pall Biotech will distribute ARTeSYN's standard hardware and liner components off the shelf.

In March, the **New Jersey Innovation Institute**, a **New Jersey Institute of Technology Corporation**, signed an Industry Participation Agreement with **Pall** to support the development of its BioPharmaceutical Innovation iLab. The partnership will support the Cell and Gene Therapy Development Center and the Center of Advanced Biologic Manufacturing.

GE Healthcare announced a digital data exchange collaboration program with **Amgen**, which will include advanced data analytics to increase the understanding of the relationship between raw material variability and process performance during the manufacture of biologic medicines. As a part of this initiative, GE Healthcare and Amgen will be installing a seamless connection for data transfer between GE Healthcare raw material manufacturing sites and Amgen's process development center in Cambridge, Massachusetts.

In March, **Merck KGaA** officially opened its €10 million (\$11 million), 43,056 ft² (4,000 m²) M Lab Collaboration Center, its first such center in Europe and the ninth worldwide. The Center provides biopharmaceutical manufacturers with a shared, exploratory environment where they can closely collaborate with Merck scientists and engineers.

Product Introductions

In March, **Sartorius Stedim Biotech** introduced integrated online biomass measurement, using noninvasive reflectance measurement, to its ambr 15 fermentation and ambr 250 high-throughput systems for microbial applications.

Process Analysis

Company Announcements

In February, **Hach** announced that following testing at the Epe Wastewater Treatment Facility in the Netherlands, Hach's instrumentation and Prognosys predictive diagnostic system was certified by **Royal HaskoningDHV** and approved for global use with the Nereda wastewater treatment process. Hach is the first global Nereda supply partner to have its equipment certified for Nereda applications. In 2017, Hach was named a preferred supplier of online analytical instrumentation to test the quality of water treated with the Nereda technology.

In February, **Yokogawa Electric** established a subsidiary in Norway with two employees. Operations will begin in April.

Product Introductions

In February, **Evoqua Water Technologies** introduced the Depolox 400 M analyzer designed to provide reliable measurements of disinfectant parameters in drinking water and industrial water applications. The analyzer can incorporate up to three well measurement parameters: a disinfectant such as free or total chlorine, chlorine dioxide, ozone or potassium permanganate, pH or fluoride, and temperature.

DKK-TOA released in February new Automatic Process Analyzer XAT300, replacing the XAT200. It automates potentiometric titration, colorimetric analysis and other techniques.

Reported Financial Results

\$ in Millions USD	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Bionano Genomics	Q4	31-Dec	\$4.0	41.1%	-\$6.1	-16.4%	-\$6.4	-8.3%
Bionano Genomics	FYE	31-Dec	\$11.5	30.7%	-\$20.4	12.1%	-\$18.50	20.8%
Other Currencies (in Millions)								
FOSS	FYE	31-Dec	DKK 378.00	-10.2%	DKK 538.00	-4.6%	DKK 2.24	0.8%
Judges Scientific	FYE	31-Dec	£77.87	9.1%	£14.73	35.4%	£8.73	133.2%
Tecan	FYE	31-Dec	CHF 593.80	8.2%	CHF 88.55	11.0%	CHF 70.70	7.3%
Tecan (Life Sciences)	FYE	31-Dec	CHF 347.30	9.0%	CHF 51.30	1.6%	NA	NA
Tecan (Partnering)	FYE	31-Dec	CHF 267.60	9.9%	CHF 48.60	15.7%	NA	NA

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