



IBO

Strategic Information for the
Life Science and Analytical
Instrument Industry

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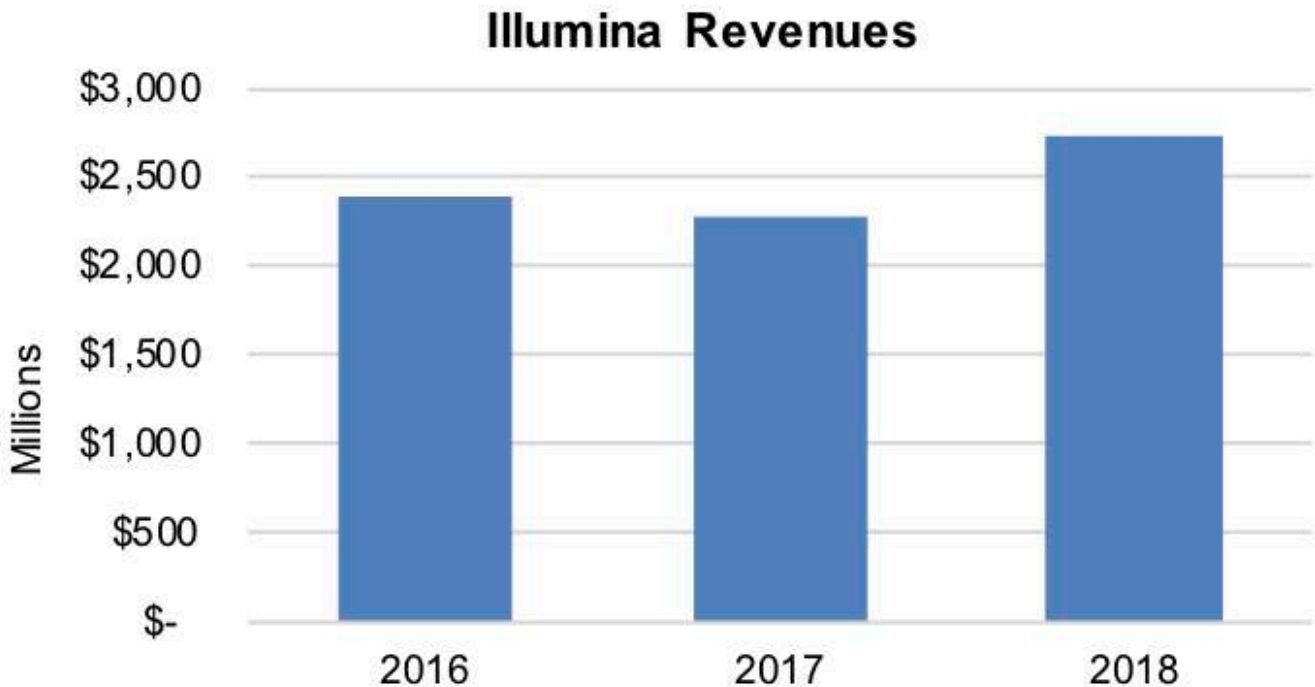
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A Big Year for Illumina

As part of its [2019 Annual Forecast Issue](#), **IBO** named Illumina our company of the year for 2018. The company's achievements included its strongest revenue growth since 2015, the adoption of its NovaSeq system by new users, and advancing the use of NGS in the pharmaceutical and diagnostics end-markets. Specifically, the year was marked

by sales growth propelled by the Genomics England population genomics program, arrays for direct-to-consumer testing and NovaSeq consumables.

The company announced its year-end results on January 29 (see [Bottom Line](#)). “Illumina delivered its 20th year of sequential revenue growth in 2018, with revenue of approximately \$3.3 billion, up 21% from 2017,” said company President and CEO Francis deSouza and Eric Endicott, senior director, Corporate Communications. Notably, the growth reflected robust sales across product lines. “Sequencing consumables grew about 23%. Sequencing systems grew about 10% and microarrays grew about 22%,” they noted.

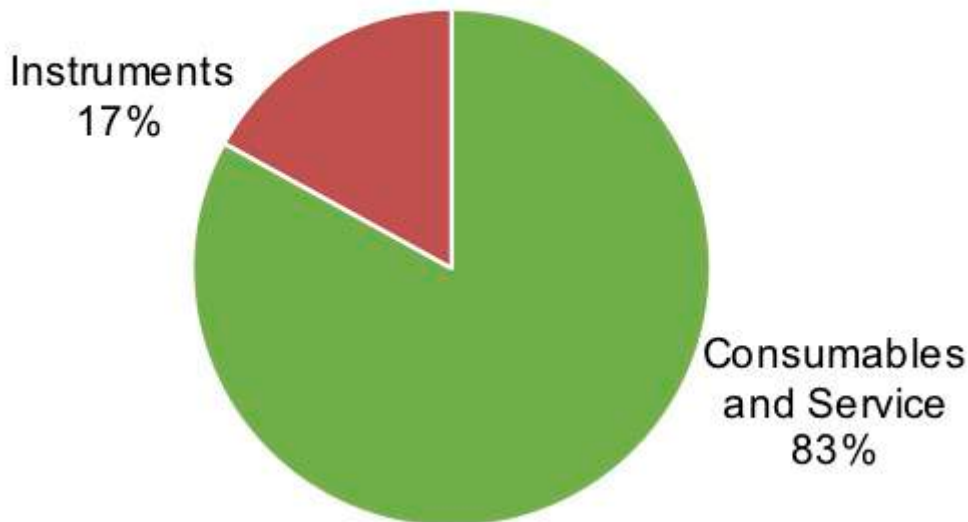


Source: Illumina

Adoption of the NovaSeq sequencer was one contributor to this growth, reflecting the ability of the company to broaden the use of whole-genome sequencing through the system’s introduction. “Customers are embracing this power to sequence larger cohorts more broadly and deeply,” they said. “Since its launch 2 years ago, NovaSeq users have sequenced more than 600,000 whole-genome equivalents. That’s 3 times as many as were sequenced on the HiSeq X in its first 2 years of launch.” The HiSeqX was previously Illumina’s highest-throughput sequencing system with an output per run of 1.8 Tb, compared to 1-6 Tb for the NovaSeq depending on the flow cell (using two flow cells per run).

Through both the replacement cycle and new users, NovaSeq’s is expected to also grow instrument and consumables revenue going forward, fulfilling a strategic goal of Illumina’s for last year. “We placed more NovaSeqs in 2018 than we did in 2017, including more than 100 units in the fourth quarter alone, a record. To date, new-to-Illumina or benchtop conversions represent approximately 30% of our NovaSeq installed base, and three-fourths of our HiSeq customers have yet to purchase a NovaSeq System,” they said. “This group represents approximately 630 HiSeq customers, supporting our confidence in a steady, multiyear transition.”

ILLUMINA 2018 REVENUES



Source: Illumina

Illumina has pointed out over the years its role in developing the NGS market as a whole. This role can be attributed to the company's market share, technology and resources. In particular, these efforts have been aimed at applications beyond the research lab. The company cited several accomplishments in 2018 in this regard in the areas of NIPT, RUGD (rare and undiagnostic genetic disease) and oncology testing, marking the maturing of these markets. "In NIPT, our VeriSeq CE-IVD customers ordered over 300,000 tests in 2018, up more than 70% from the previous year, highlighting the rapidly growing clinical NIPT opportunity," they said.

Greater reimbursement opportunities are among the most important signals of success in increasing clinical and diagnostic opportunities. "Reimbursement has made rapid progress in the last 2 years, with more than 147 million patient lives in the US now covered for RUGD whole-exome sequencing," explained Mr. deSouza and Mr. Endicott. "Last week, CMS's [Center for Medicare & Medicaid Services'] final CPT code came into effect, pricing whole-genome sequencing at more than \$5,000 for a single genome for RUGD patients. This is a critical benchmark for whole-genome sequencing in the Medicare and Medicaid populations."

Further detailing these numbers, Mr. deSouza and Mr. Endicott commented, "We're seeing significant progress in reimbursement. In 2018, 50 million additional U.S. lives gained coverage for NGS panels, bringing the total to over 200 million lives." Additionally, in 2018, regulatory and professional recognition of the NGS' utility increased. "In 2018, 5 large gene panels received breakthrough designations or approvals for therapy selection and minimal residual disease assessment, up from 1 in 2017. NCCN [National Clinical Practice Guidelines in Oncology] and ESMO [European Society for Medical Oncology] guidelines now include NGS testing for several types of cancer, including TMB assessment in lung cancer," they explained.

In oncology, NGS' largest market, the company also reported wider NGS adoption, particularly among pharmaceutical companies. "In 2018, we saw significant progress in oncology research to support basic discovery and therapy development, as well as regulatory approvals and reimbursement of oncology NGS tests that will drive increasing adoption of sequencing as a standard of care in cancer treatment," they said. In particular, they explained, adoption was strong for use in clinical trials. "For example, NGS is included in many of the 2,250 active clinical trials in immuno-oncology registered in the US, driven by the emergence of genomic biomarkers like tumor mutational burden or TMB."

Among Illumina's larger investments during the year were the purchase of two companies. One acquisition, Edico Genomics (see [IBO 5/15/19](#)), was a step up in the company's exposure to the software market for variant analysis. Edico's DRAGEN platform provides a hardware and software solution for secondary analysis of NGS data. "As sequencing is getting more adopted in the clinic/standard of care, we want to move the focus from raw data to analyzed/variant calls. Doing so allows customers to focus on higher-impact work interpretation and actionability of

information,” explained Mr. deSouza and Mr. Endicott. “By combining DRAGEN with our technologies, we’re taking data analysis from a complicated and costly process to a push-button result. The acquisition supports our informatics strategy is to provide the infrastructure that gets customers up and running—from sequencing to result—in the easiest and most cost-effective way possible.”

The other major purchase was of Pacific Biosciences (see [IBO 11/15/18](#)), giving Illumina a presence in the long-read market, and providing another path for future sales growth with new sequencing capabilities. As Mr. deSouza said on a November 2018 conference call discussing the deal, “Pacific Biosciences’ accurate native long-reads averaging 15 to 30 kilobases provide valuable insights around long-range rearrangements, structural variants and haplotypes, which can be challenging using short-read technologies.” In a January SEC Proxy filing, Pacific Biosciences estimated 2019 revenues of \$144 million, up 6.2%, and an improvement in operating income from a loss of \$83 million to a loss of \$48 million, with an operating profit expected by 2020.

With these acquisitions representing major strategic activities and future prospects, and a meaningful acceleration in revenue growth and profitability as well as market access, 2018 was a big year for Illumina.

Lab Product Companies Update Their Strategies at JP Morgan Healthcare Conference

The annual JP Morgan Healthcare Conference, held earlier this month in San Francisco, California, is a high-profile gathering for health care companies and investors. Among the 450 companies in the spotlight during the week were the largest analytical instrument and lab product companies, including PerkinElmer, Thermo Fisher Scientific and Waters. In this article, **IBO** examines some of the major themes among lab tool companies’ presentations at the conferences as well as major announcements.

Headlines

Several companies chose the occasion to preview fourth quarter 2018 and full-year financial results (see [IBO 1/15/19](#)). Also in financial news, 10x Genomics, a private firm that presented at the conference, announced a Series D funding of \$35 million, bringing total financing to \$243 million.

Other companies selected the event to preview or introduce new products. QIAGEN announced the QIAcube Connect, its next generation of its QIAcube automated sample processing system for QIAGEN spin columns, which will launch this quarter. Features include digital connections and new safety protocols. The company also announced the acquisition of N-on-One and Formulatrix’s digital PCR technology (see [IBO 1/15/19](#)). Quanterix introduced its third instrument platform, the Simoa SP-X Imaging and Detection System, designed for oncology applications, which will ship April 1, and the Corplex 10-plex assay. It features testing for 50 analytes at 10-plex, with a homebrew option.

Recurring Revenues

Many analytical instrument companies have succeeded in their efforts to become more reliant on recurring revenues as opposed to instrument sales, as evidenced by presentations at the conference. For Thermo Fisher Scientific, the largest analytical instrument and lab product company, recurring revenue accounted for 74% of total sales, consisting of 52% consumables sales and 22% software sales, through the third quarter of 2018. Thermo Fisher President and CEO Marc Casper told conference attendees, “The mix of that recurring nature, of services and consumables, continues to increase over time [as] a larger and larger portion of our business.” PerkinElmer announced 68% of its forecasted 2018 sales were recurring, defined as consumables, services and software. Waters’ recurring revenue for 2017 represented 60% of revenues in 2017, with service, chemistry and informatics accounting for 33%, 16% and 11% of total sales, respectively.

“Consumables revenue is a function of that strong installed base and yields normally anywhere from 2x to 5x that instrument revenue on an ongoing basis.”

In Danaher’s presentation, the company also emphasized its focus on recurring revenue. For the company as a whole, it now makes up 70% of total sales. Speaking at the conference, Danaher President and CEO Tom Joyce listed three types of recurring revenue for the company. “It starts with what you might consider to be the traditional razor/razor blade model, where consumables revenue is a function of that strong installed base and yields normally anywhere from 2x to 5x that instrument revenue on an ongoing basis.” Examples among the company’s analytical instrument businesses include Hach. He also listed the type of consumables specified into a process, such as FDA or validated processes, calling them “mission critical.” Business examples given here were Hach, IDT, Pall and Phenomenex. Finally, he listed service as a third part of Danaher’s consumables business, with examples being Beckman Coulter Life Sciences as well as SCIEX.

Even for less diversified businesses, consumables are becoming a larger share of revenues. For Bio-Rad Laboratories’ Life Science segment, consumables make up 48% of revenues. And for Tecan, recurring revenue accounts for 42% of sales, with 21% of revenue each from services and spare parts, and consumables and reagents.

New Markets

At the conference, company presentations demonstrated entry into new markets, whether technology or end-user markets, which can be accomplished by targeting established markets as well as participating early on in growth-stage markets. Bio-Rad Laboratories Life Sciences highlighted its successful expansion into cell biology, for which it now offers flow cytometers, cell sorters, cell imagers and counters, reagents, and antibodies. PerkinElmer highlighted its rise in the food testing market, which now accounts for 8% of sales, or over \$200 million. Abcam charted its progress in establishing a partnership business with diagnostics and therapeutics companies for creating products such as companion diagnostics and point-of-care solutions. The company has completed 300 projects since the initiative’s launch two years ago, with fiscal 2018 sales of such partnerships increasing 24% to £16.4 million (\$22.2 million at £0.74 = \$1).

For smaller companies, entry into new markets also means diversification. NanoString Technologies discussed at the conference its move beyond the oncology market into neuroscience. In 2018, non-oncology applications represented about 40% of new system sales. For Quanterix, which has established itself in the neurodegenerative disease market, a new focus is the oncology market, which the Simoa SP-X addresses. The number of oncology research publications using Quanterix systems rose 35.1% last year to 50.

“Normally, we think of these new technologies as gestating for a long time in a research setting before finding other applications.”

Early entry into a small market has been an advantage for Bio-Rad Life Sciences and Bio-Techne. At the conference, Bio-Rad summarized its strength in the digital PCR business which now spans research, applied and clinical markets, such as liquid biopsies. “Normally, we think of these new technologies as gestating for a long time in a research setting before finding other applications, applied applications,” noted Bio-Rad Chairman, President and CEO Norman Schwartz in his presentation. “But, this one, in a few short years, has become a real crossover product, finding applications not only in research and biopharma, but also in diagnostics.” Bio-Techne discussed its investments in serving the emerging cell immune cell therapy market. This business includes participation in different application segments of the patient treatment workflow, from activation of patients’ T-cell ex vivo to monitoring of chemotherapy progress before T-cell reinfusion. Bio-Techne President and CEO Charles Kummeth stated, “We have a lot of positions in this workflow. We’re only really missing a couple and, stay tuned, we’re working on this strategy.”

Company Evolutions

At the conference, a number of lab tools companies also commented on recent organizational changes. For PerkinElmer, these changes have come as the company more closely integrates its Discovery & Analytical Solutions and Clinical Diagnostics businesses. PerkinElmer Chairman and CEO Robert Friel told the audience, “We’re increasingly seeing across our customer base the idea that there is convergence, particularly in the areas of diagnostics, life sciences and food...whether it’s the technology, whether it’s the use of analytics, whether it’s the need for service, whether it’s the need for a digital front end.” Examples of specific areas of synergies he gave are product management and R&D.

Changes in R&D have also been prominent at Waters, according to Waters Chairman and CEO Chris O’Connell’s presentation. “Since I came into the company a little more than three years ago, my number one focus has been to really drive the innovation engine to continue to develop and build upon the great legacy of innovation at Waters,” he stated. “In fact, over that time period, we’ve increased our spending as a percentage of product sales by a full percentage point.” This percentage now stands at 9%.

“We significantly changed the go-to-market strategy [and] improved the ability to translate innovation into commercial success.”

For QIAGEN, one change that has been pronounced at the company was at its Life Science business, which consists of its academic, pharmaceutical and applied end-markets. QIAGEN CEO Peer Schatz told conference attendees, “The Life Sciences, a \$750 million revenue piece within QIAGEN, was a little bit under-illuminated in the last few years, and has undergone a considerable transformation in 2018. We significantly changed the go-to-market strategy [and] improved the ability to translate innovation into commercial success,” stating the advantages of the business as giving QIAGEN a foundation in research labs.

Bruker continues to make ongoing changes in many areas, following a restructuring period from 2013 to 2016. “There are things we continue to do in Operational Excellence—site consolidation and taking cost out and restructuring, that’s just part of our business system,” stated Chairman, President and CEO Frank Laukien, PhD. Future site consolidations are planned for BioSpin and Nano divisions as well as the creation of an EU shared services center this year in Warsaw, Poland.



COMING THIS MONTH

Strategic Directions International Global Assessment Report 2019

Analytical & Life Science Instrumentation

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Categories

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Techniques

5

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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GE Increases Percentage of Healthcare Sale

Boston, MA 1/31/18—GE announced on its fourth quarter 2018 earnings call that it now plans to sell off just under 50% of its Healthcare business as an IPO (see [IBO 12/31/18](#)). On the call, GE Chairman and CEO Larry Culp also confirmed that the IPO is scheduled for this year. The transfer of GE Healthcare's debt and pension is expected to net \$18 billion, which will be used to pay down GE's debt. GE Healthcare's 2018 revenue rose 4.0% to \$19,017 million. Segment profit rose 6.0% to \$3,698 million.

CNBC reported that the 50% share is an increase from the 20% share spinoff that GE originally contemplated. GE's total gross debt equals \$113 billion, according to the [Financial Times](#).

Abcam Adds New Service Capabilities

Cambridge, UK 1/28/19—Life science reagent company Abcam has purchased Calico Biolabs for an undisclosed amount. Calico Biolabs provides recombinant rabbit monoclonal antibodies, including CAL antibodies for immunoncology targets, as well as custom antibodies for companion diagnostics through partnerships with diagnostics and pharmaceutical companies. "This acquisition strategically expands our leadership in recombinant rabbit monoclonal antibody technology," stated Joyce Young, vice president of Custom Services at Abcam. "The combination of our complementary antibody engineering capabilities will further support our mission to provide our customers with access to the best antibodies for both today's and tomorrow's targets of interest."

According to an Abcam spokesperson, the acquisition will strengthen the company's presence in the diagnostics/companion diagnostics sector. "In addition, it will enhance our custom service capabilities and reinforce our leadership position in rabbit monoclonal antibody technology," she said. "This will enable us to further enhance access to high-quality antibodies for key areas of research and diagnostic development, including immunoncology." Calico Biolabs has eight employees, who are primarily focused on custom antibody engineering,

Danaher Buys Liquid Handling Firm

Washington, DC 1/29/18; Indianapolis, IN 1/30/19—Beckman Coulter Life Sciences, a Danaher business, has acquired Labcyte, a maker of acoustic liquid handling systems. Financial details were not provided. “Labcyte’s unique product portfolio complements our existing liquid handling and laboratory automation business. It provides new opportunities to develop and enhance time saving solutions for customer workflows,” commented Beckman Coulter Life Sciences President Jonathan Pratt. Danaher initially announced the acquisition on its fourth quarter 2018 earnings call. “The non-contact low-volume dispensing technique eliminates cross-contamination risks and greatly reduces fluid loss, helping scientists around the world to achieve better results,” said Danaher President and CEO Tom Joyce on the call. Applications include genomics and drug discovery.

The acquisition provides a proprietary technology to Beckman Coulter Life Sciences’ existing liquid handling business, as well as an installed base in pharmaceutical and biotech labs. Other potential synergies include Labcyte’s development of a new acoustic ionization source for MS that could be used with the MS systems produced by SCIEX, another Danaher company.

Details of UK Thermo-Gatan Case Disclosed

London, UK 1/21/19—The UK’s Competition & Markets Authority (CMA) has published the full text of its decision to review Thermo Fisher Scientific’s planned purchase of Gatan (see [IBO 12/31/18](#)). According to the report, Gatan currently supplies Thermo Fisher with cameras, filters and sample holders for electron microscopes (EMs), and, on a less regular basis, specimen-preparation products and detectors. Both companies also supply direction detection (DD) and general imaging (GI) cameras. Gatan sells the peripherals to third parties and end-users, while Thermo Fisher supplies them as part of its EM systems or to its customers. The report named Gatan as the only nonvertically integrated supplier of EM filters globally, as well as a major supplier of DD and GI cameras. In addition, the companies both sell products for specimen preparation.

The CMA document stated, “The CMA has found that there is limited demand- and supply-side substitutability between the different peripherals upstream, and between the different EMs (ie, Transmission EMs (TEMs) and Scanning EMs (SEMs)) downstream. Furthermore, the relevant competitor set and the competitive conditions for the supply of TEMs and SEMs vary depending on which peripherals the end-user needs.” The Authority further concluded, “The CMA has found that the Merged Entity may have the ability and incentive to foreclose competing TEM manufacturers from access to the Target’s filters, DD cameras and GI cameras with the aim of diverting sales to Thermo Fisher’s TEMs.”

The CMA reported that third parties are concerned about access to such peripherals following the merger, writing, “The CMA therefore believes that the Merger gives rise to a realistic prospect of a substantial lessening of competition (SLC) as a result of vertical effects arising from foreclosure in the supply of filters, DD cameras and GI cameras to competing TEM manufacturers at a worldwide level.” Discussing the horizontal effects of the merger, the document stated the Authority “found that the Merged Entity will have a high combined share in the supply of DD cameras ([70-80]%, including Thermo Fisher’s self-supply), with only one other supplier of DD cameras remaining after the Merger.”

The CMA also disclosed that Thermo Fisher and Gatan have signed long-term supply agreements with TEM suppliers JEOL and Hitachi High-Technologies conditioned on the closure of the merger. But the Authority is disregarding the agreements, stating they are not related to the merger. In addition, the CMA believes the agreements will have no impact on the merger’s potential for limiting other EM suppliers or new companies’ ability to enter the market. A final CMA report is scheduled for publication in June.

Asked to comment on the report, a Thermo Fisher spokesperson told IBO, “Regarding Gatan, we continue to

work cooperatively with Roper and the CMA and expect to complete the transaction in the back half of the year.”

HORIBA Acquires Particle Characterization Technology

Tokyo, Japan 1/28/19—HORIBA Instruments has purchased MANTA Instruments for an undisclosed amount. MANTA develops and sells nanoparticle tracking analyzers. The company has six employees. Applications of the technology include life science, semiconductor manufacturing and environmental testing. MANTA’s systems determine size distribution, number concentration, and the aggregation state of particles as large as 10 nm.

The technology is based on Brownian motion. A HORIBA Scientific spokesperson told IBO, “The key advancement of this system is the ability to work with a very large dynamic range of scattered light intensity produced by differently sized nanoparticles coexisting in a polydisperse sample. It uses advanced optics, multiple light sources and very advanced software that does not require calibration standards or use refractive index.” Asked about applications, she said, “It’s great for many types of applications. Some of the more interesting ones are exosomes, micro-vesicles, other biological particles, protein aggregation, and viruses and virus-like particles.” HORIBA had distributed the company’s systems in the US since 2017 (see [IBO 5/31/17](#)).

Thermo Fisher Scientific Sells Business

Waltham, MA 1/28/19; Tokyo, Japan 1/29/18—Thermo Fisher Scientific has announced the sale of its Anatomical Pathology business to health care firm PHC Holdings for \$1.14 billion in cash. The business, which sells microscope slides, instruments and consumables, has annual revenues of \$350 million. “We are pleased to have signed the agreement with Thermo Fisher Scientific. Their anatomical pathology business has shown steady growth with their strong customer base in global hospital markets, especially in the United States,” said PHC CEO Hidehito Kotani, PhD. The sale is anticipated to result in a net dilution to Thermo Fisher’s 2019 adjusted EPS of approximately \$0.10. The transaction is expected to close in the second quarter.

The sale provides Thermo Fisher with cash to reduce its debt level, among other priorities. Regarding capital deployment, CEO Marc Casper stated on the company’s fourth quarter 2018 earnings call, “First, our goal is to reduce debt to strengthen our balance sheet following the Patheon acquisition. We started the year with 4x leverage, and we ended the year with just over 3x leverage after reducing debt by \$2 billion.” The company ended the year with debt at \$19 billion, or 3.1x on a debt-to-adjusted EBITDA basis.

Oxford Nanopore Wins EU Patent Case

Oxford, UK 1/22/19—Oxford Nanopore has announced that the European Patent Office (EPO) has revoked Pacific Biosciences’ European Patent No. 3,045,542, whose validity Oxford Nanopore had disputed. Oxford Nanopore stated, “The EPO ruled that the claims to a single-molecule sequencing process were unsupported in the application and that the application only supported a template-directed synthesis sequencing method. As Pacific Biosciences were unwilling to accept this change, the patent was revoked.”

Last year, the companies reached an agreement in the UK and Germany involving this patent, entitled “Methods for Nucleic Acid Sequencing,” and another patent (see [IBO 5/15/18](#)) that limited sales of some Oxford Nanopore products.

Hitachi High-Technologies Invests in Electron Microscopy Components

Tokyo, Japan 1/16/19—Hitachi High-Technologies has purchased Applied Physics Technologies (AP Tech) for an undisclosed amount. AP Tech develops, manufactures and sells electron sources for electron microscopes and other instruments. Hitachi High-Technologies stated it will expand AP Tech's sales and R&D for electron source-related technologies, as well as undertake joint R&D. It also stated that AP Tech is one of a small number of companies with manufacturing technology for electron sources.

The other cathode suppliers for electron microscopy are Denka and Kimball Physics. The purchase provides Hitachi with direct access to a key component of electron microscopes and other advanced technologies. The deal comes after plans by other EM suppliers for vertical integration (see Executive Briefing).

A Strong, Positive Start to the IBO Stock Indexes' 2019 Run

Sustained volatility is the phrase that best sums up the US market's performance in the month of January. Investors braced for the worst after a tepid December 2018, and while the market continued to slow down, it was largely positive thanks to various reported corporate earnings that helped investors gain confidence.

On January 2, the financial data and software company, FactSet reported that analysts projected S&P 500 earnings for 2019 to show 7.9% growth, down from more than 10% in October 2018 when originally reported. By mid-January, the market began to turn for the better with bank and corporate earnings beginning to come in. By January 15, 88% of S&P 500 companies had posted stronger-than-expected positive results. By the end of the month, the S&P 500 had reached 7.9% growth making it the best start for the index since 1987. In addition, the Dow Jones Industrial Average posted a 7.2% gain, its best January performance since 1989.

However, things were not all positive with the 35-day US government shutdown, which occurred between December 22 and January 25. The shutdown caused significant damage to the economy. On January 28, the Congressional Budget Office reported that the shutdown reduced the US GDP by \$3 billion in the fourth quarter of 2018, and potentially could cause a reduction of \$8 billion in the first quarter of 2019. The \$3 billion figure is an estimate of the value of government work that was not performed during the shutdown. The shutdown also caused various US economic data reports to be delayed or postponed, such as the fourth quarter 2018 GDP report and December 2018 consumer spending report.

While the US government shutdown was in the forefront in the media, the US and China trade issue was progressing throughout the month. The latest development occurred on January 29 when both countries began two days of high-level talks. The tariffs the US placed on Chinese goods have started to see an effect on both countries' economies. On January 28, the Congressional Budget Office predicted that the tariffs placed on steel, aluminum and Chinese goods could cut the US' GDP by at least 0.1% on average through 2029. It also predicted US GDP growth would slow to 2.0% this year, 1.7% in 2020 and 1.6% in 2021. Both parties are expected to conclude trade discussions on March 1.

The labor market proved to be an economic sector that stayed strong throughout the month despite increasing concerns. For example, on January 4, the Bureau of Labor Statistics' labor market figure rose 3.9% from a 49-year low of 3.7%. In addition, the agency reported that the US gained 312,000 new jobs in December 2018 to bring total employment gains in 2018 to a three-year high of 2.64 million.

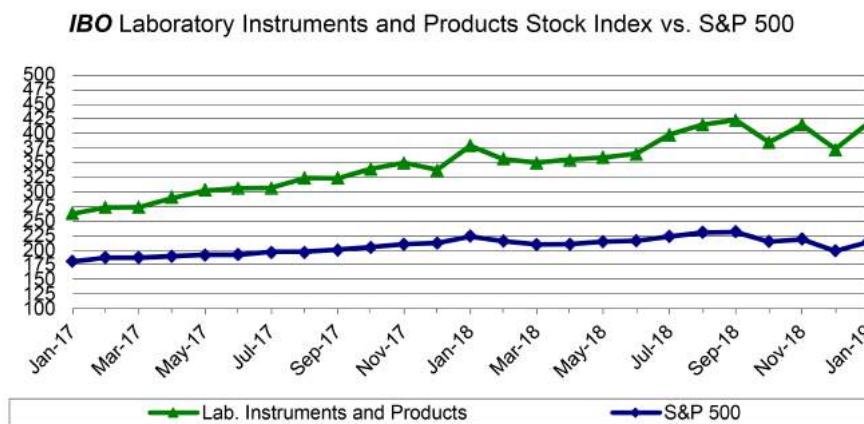
Another contributing factor to investors' confidence was the Federal Reserve's announcement on January 29 that it would pause on raising short-term interest rates, keeping the rates between the range of 2.25%-2.5%. The Fed confirmed that two rating hikes were still scheduled, yet those dates have not been announced. The Fed's reasoning for the interest rate pause is that it wants to observe how the US will operate with a strong labor market and consistent consumer spending, as well as the effects of slowing global growth, the continuing US-China trade

dispute and the partial US government shutdown.

Like the equity markets, oil prices began in a slump and recovered throughout the month, soothing any worries investors had months prior. US crude oil prices were still 30% below October 2018's multi-year highs, however, they maintained an average of \$50/barrel levels throughout the month. On January 2, the crude oil market was at its worst-performing quarter since 2014. By mid-January, oil prices starting to rebound and held steady throughout the month. This was evident on January 10, with reports stating oil prices here having a nine consecutive day winning streak, which was the longest streak since January 2010. This was unusual especially with the slowing of China's economy, Venezuela's political crisis, tense relations between the US and Iran and lagging demand of US shale gas.

Lastly, another positive yet cautious sign of investors' confidence in the US market was the widening gap between the 2-year and 10-year Treasury Yield Curve Spread, a positive indicator of US economic performance.

For January, the Dow Jones Industrial Average, S&P 500, and NASDAQ all had gains, rising 7.2%, 7.9%, and 9.7%, respectively.



[Click to enlarge](#)

Laboratory Instruments and Products Stock Index

The *Index* advanced 11.9% for the beginning of the year to 417.82. The *Index's* performance was mixed with most companies trading higher this month. The top-performing company for the month was **Nanostring Technologies**, which jumped 50%. The worst performing company for the month was **BioNano Genomics**, declining 18.3%.

Starting with this issue **IBO** has added BioNano Genomics, a life sciences instrumentation company, and **Twist Bioscience**, a manufacturer of synthetic DNA in the biotechnology industry, to the *Index*. In addition, **Enzo Biochem** and **Harvard Bioscience** have been removed.

In other news, **Waters**, on January 23, reported fourth quarter 2018 and full-year 2018 financials. The company forecasted first quarter and full-year adjusted EPS to be \$1.65-\$1.75 and \$9.20-\$9.45, respectively.

Illumina was one of the few companies in the *Index* to experience a moderate loss, decreasing 6.7%. On January 29, Illumina reported its fourth quarter 2018 and full-year 2018 financial results. The company forecasted its full-year adjusted EPS to be \$6.50-\$6.60. The adjusted EPS range is a significant increase from the reported full-year 2018 adjusted EPS of \$5.72. The company attributed this prediction to an expectation of a one-time tax benefit in relation to its **Helix** investment in 2018, which will result in an approximately 17% increase. Illumina did not provide an adjusted EPS guidance for the first quarter. In ratings news, on January 7, Morgan Stanley gave Illumina an "equal weight" rating and lowered its analyst price target from \$320 to \$288, a 6.8% downside from the January 7 price of \$309.09. In addition, on January 25, Deutsche Bank downgraded Illumina from a "buy" rating to a "hold" rating with an analyst price target of \$296.53, a 0.5% downside from the January 25 price of \$298.15.

PerkinElmer also reported its fourth quarter 2018 and full-year 2018 financial results on January 29. The company posted a fourth quarter 2018 adjusted EPS of \$1.16, an increase of \$0.02 of its guidance and a double-digit increase of 21.6%. PerkinElmer credited the EPS growth to its quarterly organic revenue growth which increased 7% to \$756.3 million (See [Bottom Line](#)). For the first quarter, the company forecasted an adjusted EPS of \$0.66, and for the full-year, the company forecasted an adjusted EPS of \$4.00-\$4.05.

On January 30, **Thermo Fisher Scientific** provided a full-year adjusted EPS guidance of \$12-\$12.20, resulting in 8%-10% growth. The guidance was adjusted to reflect a negative foreign exchange, which it predicted to occur mostly in the first half of the year.

In ratings news, on January 2, Becton, Dickinson (BD) had its price target lowered by both CitiGroup and Morgan Stanley. CitiGroup lowered the price from \$279 to \$256. Despite the lower price target, CitiGroup did give BD a “buy” rating, and the price target of \$256 is a 16.0% increase from its January 1 price of \$220.61. Morgan Stanley lowered the company’s price target from \$265 to \$240 and gave BD an “equal weight” rating on the stock. The \$240 price target is an 8.8% increase of the January 1 price of \$220.61. On January 3, **Pacific Biosciences** was downgraded by Cowen from an “outperform” rating to a “market perform” rating.

Company	Date Rep.	Fiscal Quarter	2018 Adj. EPS	Analyst Consensus	Vs. Estimate	YOY Growth	2017 Adj. EPS	
Laboratory Instruments and Products Stock Index								
ILMN	29-Jan	4Q	\$1.32	\$1.36	↓	-\$0.04	-8.3%	\$1.44
ILMN	29-Jan	FYE	\$5.72	NA	NA	NA	43.0%	\$4.00
PKI	31-Jan	4Q	\$1.18	\$1.16	↑	\$0.02	21.6%	\$0.97
PKI	31-Jan	FYE	\$3.61	NA	NA	NA	24.5%	\$2.90
TMO	30-Jan	4Q	\$3.25	\$3.18	↑	\$0.07	16.5%	\$2.79
TMO	30-Jan	FYE	\$11.12	NA	NA	NA	17.2%	\$9.49
WAT	23-Jan	4Q	\$2.87	\$2.64	↑	\$0.23	14.3%	\$2.51
WAT	23-Jan	FYE	\$7.65	NA	NA	NA	2960.0%	\$0.25
Diversified Laboratory Stock Index								
DHR	29-Jan	4Q	\$1.28	\$1.27	↑	\$0.01	7.6%	\$1.19
DHR	29-Jan	FYE	\$4.52	NA	NA	NA	12.2%	\$4.03
GLW	29-Jan	4Q	\$0.59	\$0.57	↑	\$0.02	28.3%	\$0.46
GLW	29-Jan	FYE	\$1.78	NA	NA	NA	11.3%	\$1.60
TDY	23-Jan	4Q	\$2.45	\$2.18	↑	\$0.27	33.2%	\$1.84
TDY	23-Jan	FYE	\$9.01	NA	NA	NA	43.9%	\$6.26
XYL	30-Jan	4Q	\$0.88	\$0.88	↔	\$0.00	15.8%	\$0.76
XYL	30-Jan	FYE	\$3.03	NA	NA	NA	65.6%	\$1.83

[Click to enlarge](#)

Diversified Laboratory

In January, the *Index* declined 7.7% to 230.06 solely due to a significant decrease in the market capitalization value of the *Index*. Despite the decline, all the companies experienced monthly gains. **Corning** was the only company in the *Index* to experience a double-digit increase in share price. **Roper Technologies** experienced the smallest gains, increasing only 6.3%.

On January 23, **Teledyne Technologies** reported its fourth quarter 2018 and fiscal full-year 2018 earnings. The company provided first quarter GAAP EPS guidance of \$1.87-\$1.92. The company also gave full-year GAAP EPS guidance of \$9.25-\$9.35.

On January 29, Corning reported its fourth quarter 2018 and full-year 2018 earnings. Fourth quarter 2018 adjusted EPS and full-year 2018 adjusted EPS increased 28% and 11%, respectively, due to the continued success of the company’s expansion project investments. The company did not provide an adjusted EPS forecast for the first quarter or year end.

For 2018, **Danaher’s** fiscal full-year EPS rose in the double digits for the fifth year in a row due to solid 6% core

revenue growth and a strong 17.1% operating margin growth. The company's revenue performance was attributed to new products and the prioritization of certain business initiatives. On January 29, **Danaher** announced its first quarter and full-year guidance. The company forecasted first quarter adjusted EPS of \$1-\$1.03 and forecasted full-year EPS guidance of \$4.75-\$4.85, with an expectation of core revenue growth increasing 4%.

On January 31, **Xylem** announced its fiscal full-year adjusted EPS guidance is expected to be \$3.20-\$3.40. On the same day, Xylem declared a \$0.24 dividend, a 14.3% increase.

In ratings news, RBC Capital upgraded **Honeywell** with an "outperform" rating and a \$148 analyst price target, a 2.3% increase from the January 3 price of \$144.71. In addition, on the same date, Credit Suisse Group also upgraded Honeywell with an "outperform" rating yet gave the company a \$132.06 analyst price target, an 8.7% decrease from the January 3 price. Despite this lower price target, Credit Suisse noted that Honeywell was one of the top industrial stock picks for the year, highlighting its strong balance sheet and its ability to generate above-average free cash flow. The company's shares rose 3.3% following RBC Capital's and Credit Suisse's announcements that day. On January 10, **Illinois Tool Works** was downgraded by JP Morgan Chase from a "neutral" rating to an "underweight" rating. The analyst price target was \$120, an 8.5% decrease from the January 10 price of \$131.09.

International Stocks

For the month, the Asia Pacific markets were mostly positive except for Japan's Nikkei, which had a 3.79% decline. Hong Kong's Hang Seng and the Asia Dow expanded 11.5% and 8.8%, respectively.

Starting with this issue, **IBO** has begun covering **Expedeon**, a manufacturer of tools for biological research, diagnostics and drug discovery.

Prices for most of the Pacific region companies in the **IBO** Stock Table increased this month except for **Yunnan Energy**, which declined 9.4%. The rest of the companies increased in the double digits, with **JEOL**, **HORIBA**, and **GL Sciences** recording the fastest expansions, rising 19.1%, 18.7%, and 17.1%, respectively.

In other news, **Hitachi High-Technologies** reported its fiscal third quarter 2019 results on January 31. The company forecasted its full-year 2019 EPS of ¥327.21 (\$2.90 at ¥112 = \$1).

European equity markets were positive in January. Italy's FTSE MIB and France's CAC 40 Index expanded 8.30% and 8.27%, respectively. London's FTSE 100 experienced the smallest amount of gains with a 4.13% increase.

Prices for the European stocks in the **IBO** Stock Table were mixed as well, with most companies showing gains in January. **Abcam** had the biggest gains this month with a 21.7% increase, followed by **Sartorius** that rose 21.4%. In contrast, **Horizon Discovery** was the biggest loser declining 12.0%. On January 8 and 29, Abcam and Horizon Discovery made pre-trading announcements respectively (See [Life Science Consumables](#)).

On January 15, **Oxford Instruments** authorized the listing of 150,000 shares which will be traded on the London Stock Exchange starting on January 17. The shares were listed by Oxford Instrument for the purpose of its Performance Share Plan, an employee benefit that would allow its employees to earn stock in the company if or when a specific financial target is reached. The stocks were priced at 5 pence a share.

On January 29, Sartorius announced its full-year results, posting a 21.9% increase in basic EPS to €2.56 (\$3.28).

In ratings news, on January 10, JP Morgan Chase restated Abcam's "neutral" rating in a research report. On January 16, JP Morgan Chase raised Spectris' price target from 2,900 pence (\$37.89) to 2,965 pence (\$38.74) and gave the company an "overweight" rating. In addition, on January 21, Halma's "sell" rating was reaffirmed by UBS Group.

Company: Exchange	Market Value (US M)	52-Week Range		Price 1/31/2019	Change 1 Month	Change YTD	P/E (ttm)	EPS (ttm)
		Low (\$)	High (\$)					
Laboratory Instruments and Products								
Agilent Technologies: n	\$24,224	60.42	76.31	\$76.05	12.7%	12.7%	27	2.79
Becton, Dickinson and Company: n	\$66,920	208.62	265.87	\$249.46	10.7%	10.7%	23	10.97
BioNano Genomics: o	\$44	4.01	10.00	\$4.37	-18.3%	-21.8%	NM	-0.63
Bio-Rad Laboratories: n	\$6,212	220.05	345.15	\$249.87	7.6%	7.6%	48	5.22
Bio-Techne: o	\$6,589	128.06	206.04	\$174.46	20.6%	20.6%	38	4.55
Bruker: o	\$5,624	26.10	36.28	\$35.06	17.8%	17.8%	26	1.37
Fluidigm: o	\$421	4.65	9.56	\$8.65	0.3%	0.3%	NM	-1.04
Illumina: o	\$41,129	207.51	372.61	\$279.79	-6.7%	-6.7%	49	5.72
Kewaunee Scientific: o	\$88	22.00	38.80	\$32.20	-3.1%	-3.1%	21	1.54
Luminex: o	\$1,243	18.62	35.37	\$27.89	20.7%	20.7%	45	0.62
Mettler-Toledo: n	\$15,983	500.74	685.00	\$638.16	12.8%	12.8%	33	19.48
MTS Systems: o	\$895	38.42	57.00	\$50.06	24.7%	24.7%	26	1.96
NanoString Technologies: o	\$686	5.87	22.41	\$22.24	50.0%	50.0%	NM	-2.45
Pacific Biosciences: o	\$1,030	2.02	7.84	\$6.92	-6.5%	-6.5%	NM	-0.74
PerkinElmer: n	\$10,067	70.74	98.33	\$90.50	15.2%	15.2%	25	3.62
QIAGEN: o	\$8,389	31.01	39.45	\$37.03	7.5%	7.5%	27	1.37
Quanterix: o	\$418	13.00	23.99	\$21.06	15.0%	15.0%	NM	-8.30
Thermo Fisher Scientific: n	\$98,901	194.51	253.91	\$245.67	9.8%	9.8%	22	11.12
Twist Bioscience: o	\$646	12.38	34.46	\$23.13	-10.6%	0.2%	NM	-6.59
Waters: n	\$17,514	167.94	232.33	\$231.22	22.6%	22.6%	28	8.33
Diversified Laboratory								
AMETEK: n	\$16,921	63.14	81.92	\$72.90	7.7%	7.7%	23	3.13
Corning: o	\$26,621	26.11	36.56	\$33.26	10.1%	10.1%	19	1.79
DanaHER: n	\$77,744	91.84	111.10	\$110.92	7.6%	7.6%	25	4.52
Honeywell: n	\$106,328	123.48	162.52	\$143.63	8.7%	8.7%	18	7.95
Illinois Tool Works: n	\$45,560	117.75	174.64	\$137.31	8.4%	8.4%	18	7.47
Roper Technologies: n	\$29,274	245.59	312.65	\$283.26	6.3%	6.3%	25	11.29
Teledyne Technologies: n	\$8,090	172.80	250.87	\$224.22	8.3%	8.3%	25	9.01
Xylem: n	\$12,807	60.65	82.44	\$71.26	6.8%	6.8%	25	2.84
Laboratory Instruments and Products				\$417.82	11.9%	11.9%	29	
Diversified Laboratory				\$230.06	-7.7%	-7.7%	22	
Dow Jones Industrial Average				\$24,999.67	7.2%	7.2%		
S&P 500				\$2,704.10	7.9%	7.9%		
NASDAQ Composite				\$7,281.74	9.7%	9.7%		
Region	Market Value	52-Week Range		Price	Change	Change	P/E	EPS
Company	(Local M)	Low (L)	High (L)	1/31/2019	1 Month	YTD	(ttm)	(ttm)
Pacific Shares								
GL Sciences: t	¥16,863	¥1,170	¥2,247	¥1,507	17.1%	17.1%	10	¥144.01
Hitachi High-Technologies: t	¥539,941	¥3,130	¥5,380	¥3,920	13.5%	13.5%	5	¥817.36
HORIBA: t	¥226,685	¥4,155	¥9,590	¥5,330	18.7%	18.7%	5	¥1,032.02
JEOL: t	¥96,401	¥1,194	¥2,595	¥1,973	19.1%	19.1%	42	¥46.90
Precision System Science: os	¥7,596	¥236	¥679	¥303	13.1%	13.1%	NA	¥50.51
Shimadzu: t	¥738,695	¥2,008	¥3,670	¥2,495	14.8%	14.8%	21	¥121.48
Yunnan Energy: hk	HKD 848	HKD 1.9	HKD 5.2	HKD 3	-9.4%	-9.4%	NM	(\$0.01)
European Shares (London)								
Abcam: l	£2,726	£10.06	£15.88	£13.27	21.7%	21.7%	44	£0.30
Halma: l	£5,315	£11.36	£15.07	£14.00	2.6%	2.6%	28	£0.50
Horizon Discovery: l	£232	£1.28	£2.52	£1.54	-12.0%	-12.0%	NA	£0.14
Oxford Instruments: l	£516	£6.76	£11.16	£8.99	-1.2%	-1.2%	15	£0.61
Scientific Digital Imaging: l	£31	£0.12	£0.47	£0.35	-0.7%	-0.7%	18	£0.02
Spectris: l	£3,005	£19.24	£29.57	£26.01	14.1%	14.1%	26	£0.99
European Shares (Other)								
Biotage: st	SEK 7,550	SEK 68.40	SEK 145.00	SEK 115.80	6.2%	6.2%	43	SEK 2.70
Datacolor: s	CHF 124	CHF 720.00	CHF 900.00	CHF 740.00	0.0%	0.0%	19	CHF 38.54
Expediton: g	€ 54	€ 0.70	€ 1.40	€ 1.04	12.0%	15.8%	NM	€ 0.00
Merck KGaA: g	€ 11,774	€ 75.26	€ 100.10	€ 91.10	1.5%	1.5%	20	€ 4.46
Sartorius: g	€ 4,362	€ 82.00	€ 140.50	€ 116.50	21.4%	21.4%	19	€ 6.10
Tecan: s	CHF 2,361	CHF 178.60	CHF 256.00	CHF 200.60	5.1%	5.1%	63	CHF 3.18

The IBO Stock Indexes are weighted by market 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.

Metabolomics Software for MS

In recent years, the most common areas for bioinformatics software to cover have been various molecular biology research studies referred to as “omics,” including proteomics (for proteins), genomics (for DNA) and metabolomics (for metabolites). Of these, metabolomics is one of the newer frontiers. It is less established than other omics, but makes a huge impact in a wide variety of scientific studies, including drug discovery, food safety, toxicology and biomarker discovery. At its core, metabolomics examines the quantitative and qualitative changes of small molecules within a biological specimen, such as a cell or tissue. One of the primary techniques to conduct such studies is MS, where bioinformatics must have sufficient processing power and fast data access to work with very large data files.

Every major MS instrument supplier already has their own acquisition software for each platform that is generally included with the initial purchase. However, most analytical labs use multiple brands and instruments, and there is no such thing as a single MS software package that handles every type of analysis. For this reason, analytical labs will often install specialized software, either from their primary MS provider or from a third party. These bioinformatics solutions typically run on the backend, where data has already been acquired and is available in open format. This way, data from each instrument can all get processed the same way. Metabolomics software is useful for both GC/MS and LC/MS, but it is far more prevalent and useful in the latter technique. The solutions vary in what workflows they offer, but their functionality can be categorized into three areas: preprocessing, annotation and statistical analysis.

In order for MS data from metabolomics to be analyzed, preprocessing software first makes adjustments to the data using several methods. One of the first tasks to be done is peak picking, whereby important information from the MS peaks is extracted from the raw data. This can be done automatically by setting the proper search parameters, or it can be done manually. A deconvolution tool is usually employed next to recalculate all species with a multiple charge into a single-charge form so that they can be grouped together according to their m/z value and peak width. This is needed for dealing with overlapping peaks within the same metabolite. Metabolomics software may also include smoothing or noise reduction tools to remove signal distortion, and baseline correction abilities to adjust for baseline drift that shifts the mass spectrum from its origin. Peak matching and peak alignment are other crucial steps in the preprocessing stage. Because the results never align perfectly, the software helps the analyst determine which peaks belong to the same molecule by looking at their m/z ratio and retention time.

Within annotation software, MS peaks representing adducts, isotopes and fragments are identified via library or by manually searching metabolite databases. Some software packages even allow searching multiple databases at the same time. Particularly in LC/MS, it is not quite as straightforward as definitively assigning each peak to a known compound. The process is actually quite time-consuming and far from automated. There are frequently false positives, and analysts often resort to putting their data through multiple data packages. The Metabolomics Standards Initiative (MSI), published in 2007, offers a series of reporting standards for results related to metabolite identification. The MSI criteria define four levels of metabolite identification, with level 1 reserved for identified metabolites, levels 2 and 3 for putatively annotated compounds and putatively characterized compound classes, respectively, and level 4 for unknown compounds. This standard was created in order to provide clarity and consistency in scientific literature for metabolomics studies. Despite these good intentions, however, many studies do not strictly adhere to these guidelines and other variations on the standard have since been proposed.

Once the annotation process is complete, postprocessing software is used to further refine the data using several methods. This includes applying parameter thresholds to signal-to-noise ratio, calculating the minimum percentage of samples in which a feature must be present to be included in the data, filling in missing values with imputation and deciding which aspects of the data should be emphasized in order to assess the relevant information. Once such measures are complete, the MS data will exist as a matrix of signal intensities, where various statistical methods can then be applied.

The offerings that are included in metabolomics software for MS vary quite a bit and may exist in the form of web apps, R packages, Windows software, etc. Some include only one particular function, while others offer workflow solutions that cover nearly every task from preprocessing to statistical analysis. There are roughly a couple hundred products to choose from, some of them free and some of them at a significant price point. It is worth noting that it is

not unusual for MS vendors to collaborate with third-party software developers.

XCMS software developed by Scripps Research Institute is perhaps the most common metabolomics solution for untargeted MS studies, boasting rapid acquisition and a robust set of algorithms to align features, identify peaks, perform statistical analysis and visualize complex results. It is currently owned by Mass Consortium, but the software is exclusively sold through SCIEX. Thermo Fisher Scientific's signature offering for metabolomics-based MS is Compound Discoverer, an integrated set of libraries, databases and statistical analysis tools ideal for Orbitrap mass spectrometers analyzing small molecules. The latest version of this software was released in June 2018. It helps identify compounds using multiple databases, including mzCloud, Chemspider and more. Waters offers Progenesis QI software for small molecules and lipids, with its latest version from 2017. Other popular options are no cost, including MetaboAnalyst, a web-based tool for statistical analysis, and OpenMS, a library for LC/MS data that offers metabolite quantification and identification.

The entire market for MS software was over \$300 million in 2018, and it is estimated that about one-fifth of end-users engage in some form of metabolomic studies. Of course, the software used for such activities is a mixture of open source no-cost analytical tools and closed source commercial software. Regardless, growth for specialized metabolomics software for MS is expected to be generally robust over the next few years, driven by an increasing number of biology and drug correlation studies sponsored by pharmaceutical companies. In the meantime, there is plenty of demand for solutions that alleviate the bottlenecks of the annotation phase.

Metabolomics Software for MS at a Glance:

Largest Markets

- Academia
- Pharmaceuticals
- Biotechnology

Leading Suppliers

- SCIEX (Danaher)
- Thermo Fisher Scientific
- Waters

Software Cost

- \$0–\$20,000

Endpoint: IMF Forecast

Since the January 15 publication of *IBO's 2019 Annual Review and Forecast Issue*, the International Monetary Fund (IMF) has issued an update to its October 2018 World Economic Outlook. The update, released earlier this month, revised its 2019 and 2020 forecast downwards. This was the Fund's second projected downturn in three months, due to unresolved trade conflicts, as well as weakness in European and emerging markets. Overall, the IMF reduced its global economy forecast to 3.5% growth in 2019 and 3.6% growth in 2020, a decrease of 0.2 and 0.1 percentage points, respectively, from the Fund's October 2018 projections.

After two years of steady growth, global economic development is decelerating while risks are rising. The slowing economic growth in China was cited by the IMF as being larger than expected, and the possible lack of a Brexit deal could further exacerbate already precarious market conditions. Also in Europe, new fuel emissions standards for cars have negatively impacted Germany, the leading exporter on the continent, as have market pressures caused by Italy's budget discussions with the EU. The IMF decreased its European forecast by 0.3 percentage point to total 1.6% growth in 2019 but kept its 1.7% projection for 2020.

The growth forecast for developing countries was also decreased, falling 0.2 percentage point to 4.5% for 2019. This decline is largely attributed to trade issues, capital outflows, unpredictable oil prices and growing US interest rates.

Projections for 2020 held steady at 4.9%. In Latin America, economic growth is expected to rebound over the next two years to 2.0% in 2019 and 2.5% in 2020, a decrease of 0.2 percentage point. The downturns of economic growth in Latin American countries such as Argentina, Mexico and Venezuela, will be slightly offset by Brazil, which is on an upward recovery from its 2015-16 recession.

US growth projections remain unchanged by the IMF, which projects growth of 2.5% in 2019 and 1.8% in 2019, thanks to strong domestic demand. The UK's forecasted growth stayed the same at 1.5% for 2019, contingent on an organized exit from the EU. China's forecast also remained the same at 6.2% for the next two years, but the IMF warned that economic growth could fall short of this projection if trade conflicts continue. Economic growth in China slowed in fourth quarter 2018 due to unsteady domestic demand and tensions with the US over tariffs, which brought 2018 economic growth to the lowest levels in almost 30 years.

One of the few countries to receive an upward revision in its forecast was Japan, with the IMF increasing growth projections by 0.2 percentage point to 1.1% in 2019. The rise is a result of increased government fiscal measures, including initiatives to offset the effects of the consumption tax rate increase that is planned for October. India's forecast was also increased by 0.1 percentage point to growth of 7.5% in 2019 and 7.7% in 2020, due to lower oil prices and a calming of inflation pressures.

Pharmaceuticals

Over the past 10 years, leading pharmaceutical companies have had little returns on the expensive process of finding new drugs, with the average return on R&D at 12 of the world's largest companies falling to 1.9% in 2018. This signifies the lowest level of ROI in the pharmaceutical industry in more than a decade, while the cost of drug discovery has risen dramatically. The low return rate is comfortably below the cost of capital, which is the rate at which companies are able to borrow money. The mostly futile R&D investments have resulted in major drug companies developing smaller numbers of therapies in their pipelines.

With this transforming the pharmaceutical landscape, drugmakers are increasingly looking to acquiring smaller companies. Pharma giants are able to provide larger distribution to smaller companies which, without wide reaching distribution, are unable to capitalize from sales of new therapies as quickly. The most recent acquisitions of smaller drug companies are largely due to the impression that biotechnology companies are not as expensive to acquire. In late 2018, investors focused on stocks that were seen as less risky, which negatively impacted unpredictable smaller companies, such as biotechnology firms, resulting in a 25% decline in the Nasdaq index of biotechnology firms in the fourth quarter of 2018. Come January, biotech companies seem to be trading at a stock market discount, causing pharmaceutical companies to begin the year with a takeover boom, with Bristol Myers Squibb and Eli Lilly purchasing Celgene and Loxo Oncology for \$90 billion and \$8 billion, respectively.

Source: [The Economist](#)

Energy

Global clean energy investments in 2018 totaled \$332.1 billion, an 8% decrease, but the fifth consecutive year that investments have exceeded \$300 billion. In Europe, clean energy investments jumped 27% to \$74.5 billion. Global venture capital and private equity investments reached their highest levels since 2010, leaping a staggering 127% to \$9.2 billion.

The greatest changes were in the solar sector, with total solar investments falling 24% to \$130.8 billion. This was largely due to falling capital costs and major policy changes in China, with the Chinese government dampening the solar boom in the country by limiting access to new initiatives for its feed-in tariff. Because of this, China's solar investment in 2018 plummeted 53% to \$40.8 billion.

Offshore wind projects received solid investments in 2018 totaling \$25.7 billion, a 14% increase. Onshore wind initiatives received \$100.8 billion in investments, but this reflects only a 2% increase. Other renewable energy

sectors that received significant investments in 2018 were biomass and waste-to-energy, with investments increasing 18% to \$6.3 billion, as well as biofuels, for which investments grew 47% to \$3 billion. Investments in the geothermal sector also increased, jumping 10% to \$1.8 billion. However, investments in small hydro, and utility-scale renewable energy projects and small-scale solar systems around the world declined in 2018, slipping 50% and 13% to \$1.7 billion and \$266.5 billion, respectively.

Corporate R&D spending on clean energy in 2018 also dropped, falling 6% to \$20.9 billion. Government R&D spending, however, grew 4% to \$15 billion. Public market investments in specialist clean energy companies climbed 20% to \$10.5 billion. China led the renewable energy market in 2018, but its \$100.1 billion in investments was down 32%.

Source: [BloombergNEF](#)

Food

According to data by Oceana, a campaign group, approximately 20% of seafood test samples in retail and catering sectors are mislabeled. Europol, the EU's law enforcement agency, has echoed these claims, reporting that of all food sectors, seafood is the most vulnerable to global counterfeit. This is largely due to the fact that organized crime syndicates, such as the Italian mafia, have become involved in food production, which gives them room to launder money while receiving large profits. The global illegal fish industry, for example, has an estimated value of \$20-\$25 billion each year, and because the industry does not uniformly follow safety and welfare standards, consumers are vulnerable to food poisoning and food fraud.

In the fish supply chain, organized crime syndicates are engaged in multiple stages from trawling to processing to distribution, due to their control over restaurants and markets. Europol's latest operation on untested and fraudulent food led to the dissolution of 50 organized crime groups and 750 arrests. According to the agency, factors such as traceability, standardization and cooperation are essential to fighting food crime. Thanks to increased customer awareness of misleading labels, retailers have begun to vie for certification from reputable standards organizations; additionally, EU rules have been tightened to require labeling with the scientific names and origins of all fish products.

Further empowering law enforcement officials fighting food crime are scientists, who are needed to provide analyses in the field. Investments in DNA tests, which would enable scientists to essentially work as forensic investigators of food products, will also provide law agencies such as Europol the means to rapidly and more accurately target mislabeled and fraudulent products.

Source: [Financial Times](#)

China

China continues to dominate growth in R&D, with Nikkei and Elsevier ranking the country first in the world with the largest share of research papers in 23 of 30 fields that generate the most interest. These fields include monoatomic layers, sodium ion batteries, nucleic acid-targeted cancer treatment, biofuel cells and lithium ion batteries. The US ranked number 1 in the remaining 7 categories, which consist of Zika virus infection, immune therapy, genome editing, intercellular signaling, intestinal bacteria, use of carbon dioxide and laser melting.

Beyond the volume of research papers, China's quality of research has been steadily improving over the past few years, comprising 11% of global papers that made the largest impact. The spike in scientific research comes after a solid increase in R&D investment, with the country more than tripling R&D spending between 2010 and 2016. Domestic R&D investment was \$410 billion in 2016, trailing close behind the US's \$464 billion in domestic R&D investment. China has also increased the number of papers it published in scientific journals by 27% over 5 years to 510,000 in 2017. Although the US ranked first with 560,000 papers, the country's output has largely plateaued.

China's rapid rise in R&D activity is to a great extent due to its focus on investing in areas that have commercial potential, specifically material science applications in electronics and electric vehicles. As per the country's Made in China 2025 campaign, China is refining its R&D process to become a manufacturing powerhouse by 2025 and a world leading producer by 2049.

Source: [Nikkei Asian Review](#)

India

Housing the third-largest scientific and technical prowess in the world, India's gross expenditure of R&D (GERD) grew 59.0% to \$16.27 billion in 2016-17. With major economic growth propelling the country forward, India's medical technology sector is projected to jump 36.8% to \$7.8 billion in 2020, and an additional 23.1% to \$9.6 billion in 2022. India is also the third-largest technology startup hub, with one thousand new companies in 2017 alone. Engineering R&D and product development is projected to grow at a CAGR of 20.55%, reaching \$45 billion by 2020.

Investments from the private and public sector have helped foster GERD in India, with R&D investments expected to expand 8.3% to \$83.27 billion in 2018. The federal government has promoted R&D through initiatives such as IMPRINT (Impacting Research Innovation and Technology) by the Department of Science and Technology and Ministry of Human Resource and Development, and the Atal Innovation Mission for accelerating innovation amongst researchers, entrepreneurs and academics.

Looking ahead, developments in nanotechnology are forecast to transform the Indian pharmaceutical industry, and the technological innovation of India's Green Revolution is projected to reform the country's agriculture sector.

Source: [India Brand Equity Foundation](#)

Estonia

Since it joined the EU in 2004, Estonia has reformed and updated its research base to the tune of €1 billion (\$1.1 billion), now having strength in fields such as ecology, genetics and molecular biology. The nation spends little of its own federal funds on R&D spending, depending mostly on research projects that are linked to the EU; however, the rise in research infrastructure and development highlights the progress a small country can achieve with the support of international collaborations and effective domestic policies.

One of the smallest developed countries in the world, Estonia has a population of 1.3 million, with a research community of a little over 3,000 full-time researchers in academic institutions, and a moderate amount of small- and medium-sized technology companies. Since the 2000s, however, economic growth has boomed and, with the help of EU funds, public science spending began to rise, skyrocketing 87.5% from €80 million (\$90.0 million) in 2007 to over €150 million (\$170.6 million) by 2013.

The country also worked on establishing international networks, with 60% of Estonia's published research output involving international collaborations, a share similar to Netherlands and Ireland. Additionally, the country welcomed the digital boom in the 1990s, with all Estonian schools and universities fully equipped with computers connected to the internet by 2001. Because of this, Estonia is now one of the most advanced digital ecosystems on the planet. This strong digital environment facilitates data-intensive research, with Estonia's biobank, which now includes genetic and health information for nearly 150,000 citizens, over 20% of the country's adult population.

The country's government has pledged to boost government R&D spending from 0.5% to 1% of GDP by 2020.

Source: [Nature](#)

Broad-based Companies

Company Announcements

In December 2018, **Techcomp** announced the change of its name to **Yunnan Energy International**.

[The Mercury News](#) reported in December 2018 that **Bio-Rad Laboratories** is expanding in Pleasanton, California, with the purchase of 101,000 ft² (9,383 m²) of space for its digital biology business.

Bio-Rad Laboratories announced in January that Executive Vice President and CFO Christine A. Tsingos will retire, effective April 30. She has served as CFO for 16 years.

Biotage in January nominated CEO Torben Jørgensen to the Board and proposed that he be elected chairman once he leaves his position as CEO.

In January, **Phenomenex**, a **Danaher** company, opened an office in Taiwan to provide direct sales and support.

Shimadzu Scientific Instruments (SSI) announced in January a partnership with **Hocking College** to launch the Hocking College Cannabis Analytic Lab and the first-of-its-kind Cannabis Lab Technician Associates of Science Degree. SSI also awarded a Shimadzu Partnership for Academics, Research, and Quality of Life (SPARQ) grant to the College enabling the purchase a wide range of testing equipment.

Spectris announced in January that Group Finance Director Clive Waters will retire from the company, effective April 1, and be replaced by Derek Harding, who will replace him on the Board.

In January, **Agilent Technologies** elected software executive Mala Anand, president of **Intelligent Enterprise Solutions and Industries**, to its Board, effective March 20.

In January, [Biospectrum](#) reported that **Agilent Technologies** has inaugurated a Center of Excellence in Mumbai, India, joining similar facilities in Manesar and Bangalore.

In January, **Diploma** named Johnny Thomson as CEO, effective February 25. He most recently served as Group Finance Director of **Compass Group**.

Gerhardt named in January **Supertec** as its exclusive partner in Argentina.

In January, **Merck KGaA** announced that 10 startups have joined its Accelerator program for three months at the Merck Innovation Center in Darmstadt, Germany. Some of the startups will also have the opportunity to extend their stay by joining the company's China Innovation Hub in Shanghai. Among the startups are **Ourotech**, which uses proprietary hydrogel that can culture tumors outside of the human body and replicate drug resistance inside the human body; **Nanosor**, which is developing a customizable sensor platform that is capable of multi-parameter diagnosis on objects ranging from ions to proteins and DNA; **Hafnium Labs**, which develops simulation software to enable accurate prediction in chemistry research; and 3D bioprinting company **Next Bio Innovation Labs**.

[Area Development](#) reported in January that **Promega** is building a new \$190 million R&D facility in Fitchburg, Wisconsin, which will create one hundred jobs.

In January, **BIOKÉ**, a business unit of **Cell Signaling Technology Europe**, announced an agreement with **OLS OMNI Life Science** to distribute OLS' CERO benchtop 3D incubator and bioreactor, and OLS' CASY Cell Counter and Analyzer in the Netherlands, Belgium and Luxembourg.

In January, **Crystal Finance** announced the closing of a \$27.5 million Senior Credit Facility for **KPM Analytics**, consisting of a \$21.0 million term loan, a \$3.0 million revolving credit facility and a \$3.5 million delayed-draw term loan. Proceeds from the transaction will be used to refinance existing debt facilities in multiple jurisdictions, finance working capital needs and provide additional debt capacity for future add-on acquisitions.

For the fiscal year ending November 30, 2018, sales for **Porvair's** Laboratory division, comprised of **Seal Analytical**, **Porvair Sciences** and **JG Finneran**, grew 12.0% to £41.2 million (\$54.9 million), with external revenue

rising 9.6% to £38.7 million (\$51.6 million) to make up 30% of revenues (see [Bottom Line](#)). Adjusted operating profit grew 3.2% to £6.5 million (\$8.7 million). Within JG Finneran, sales of bioscience filtration media increased 26%.

Sartorius' 2018 sales grew 11.5% to €1,566 billion (\$1,842 billion), or 13.2% in constant currencies (see [Bottom Line](#)). EBITDA grew 14.7% to €1,662 billion (\$1,955 billion). Bioprocess Solutions Division (BPS) sales rose 13.1% to €1,143.1 billion (\$1,344.8 billion), or 14.8% in constant currencies. **Umetrics** added 0.5 percentage points to growth. BPS EBITDA was up 15.7% to €326.9 million (\$384.6 million). Lab Products & Services Division's (LPS) revenue grew 7.3%, 9.1% on a constant currency, to €423.0 million (\$497.6 million), to which **Essen Bioscience** contributed 2.5 percentage points of growth. LPS EBITDA rose 10.4% to €78.1 million (\$91.9 million). For 2019, the company is forecasting sales to increase 7%-11%, with BPS sales expected to grow 8%-12% and LPS revenue increasing 5%-9%.

In January, **Merck KGaA** announced it was granted US Patent No. US 10,193,695, which relates to the formation of "cryptoobjects," a novel security procedure linking AI and blockchain technology. The technology paves the way for established identification processes (for example, barcode scanners or mass spectrometry) to be combined with blockchain and machine learning technologies to provide a novel, integrated security approach, and thus certainty and defense to businesses.

GE Healthcare reported that fourth quarter 2018 Life Sciences revenue grew 10%, with orders up 13% organically including a 20% increase in Bioprocess orders.

Life Science Consumables

Company Announcements

Streck announced in December 2018 a distribution agreement with **Farmalatina** for Chile.

Gene-based Analysis

Company Announcements

In December 2018, **Twist Biosciences** updated its legal proceedings with **Agilent Technologies** (see [IBO 2/15/16](#)), including a trial date scheduled for February 2020. The Court denied Agilent's motion for a protective order, which sought to limit the discovery that Twist and CEO Emily Leproust, PhD, could seek in the case. In addition, the Court granted Agilent's motion for leave to amend its complaint, which, according to Twist, did not address the merits of any of the new allegations or claims that Agilent seeks to add to the case.

Biotech firm **genOway** acquired in December 2018 exclusive rights to **Merck KGaA's** foundational genome editing patents to produce and sell rodent models. genOway will also develop a network of sublicensees in both the model creation and distribution businesses, and preclinical services for all potential applications.

In December 2018, **ERS Genomics** and **Lonza Pharma & Biotech** announced a license agreement to provide Lonza with access to ERS Genomics' CRISPR/Cas9 genome editing technology patents. Lonza will have the ability to utilize CRISPR/Cas9 in its bioproduction products and services, and also for use in iPSC for research applications.

In December 2018, **Horizon Discovery** entered an exclusive partnership with drug discovery firm **C4X Discovery Holdings** to validate targets and develop next generation oncology drugs. C4XD will fund the work plan, and should C4XD discover preclinical drug candidates, it intends to out-license them to clinical development partners, with Horizon receiving an undisclosed share of revenue received by C4XD.

Horizon Discovery pre-announced in January its 2018 financial results, stating that revenues rose 60.8%, 66% in constant currency, to £58.7 million (\$78.3 million). Organic revenues rose 9.5%, 12% in constant currency, to £30.1 million (\$40.1 million). Research product revenue grew 148.4% to £31.3 million (\$41.7 million), as **Dharmacon** revenue totaled £28.7 million (\$38.3 million). Applied product revenue rose 47.1% to £15.0 million (\$20.0 million).

Services revenue declined 21.2% to £10.8 million (\$14.4 million).

In January, **Horizon Discovery** entered into an exclusive strategic partnership with **Rutgers, The State University of New Jersey**, to develop and commercialize a novel gene editing technology, known as base editing. The technology potentially has applications in the development of new cell therapies, and will augment Horizon's research tools and services. Horizon Discovery made a nonmaterial payment to Rutgers for an option to exclusively license the base editing technology for use in all therapeutic applications. Horizon Discovery will also fund further research in base editing at Rutgers University while undertaking evaluation and proof-of-concept studies.

In January, **Horizon Discovery** appointed Jayesh Pankhania as CFO and a Board member, succeeding Richard Vallacott. Mr. Pankhania previously served as interim CFO of the company and CFO of **Xtera**.

In January, **Horizon Discovery** extended its CRISPR Screening Service to include ex vivo T lymphocytes.

Gene editing technology firm **Inscripta** announced in December 2018 a new \$30 million investment from existing funders, bringing the total raised to \$85.5 million.

In January, **Promega** announced that its latest PCR-based microsatellite instability (MSI) technology was granted innovation designation by the **Chinese National Medical Products Administration** (NMPA). With innovation status, the path to become classified as an IVD will gain elevated efficiency by having a program coordinator assigned from NMPA and priority status for multiple processes. In the US, Promega intends to seek FDA approval for IVD status of the MSI 1.2 platform.

Promega signed in January a license agreement with the **Broad Institute of MIT and Harvard** to sell tools and reagents for CRISPR-Cas9 gene editing. Under the agreement, Promega will combine CRISPR-Cas9 technology with its products that knock-in Promega genetic reporters.

GreenLight Biosciences, a bio-performance company developing RNA-based solutions for agriculture and pharmaceutical applications, announced in January a \$50 million first closing of its latest funding round, led by **S2G Ventures, Baird Capital** and **Blue I/O**.

Product Introductions

In December 2018, **Illumina** released the Infinium Global Diversity Array, a high-density genotyping array developed for and inspired by the **All of Us Research Program**. Illumina will provide the Array to process up to one million samples to the three genome centers awarded All of US funding, which will also be provided with Illumina's NovaSeq Sequencing Platform.

Cell-based Analysis

Company Announcement

Emulate announced in December that it has received a \$2 million research grant from the **NIH's National Center for Advancing Translational Sciences** to use its Intestine-Chip to conduct experiments that will provide insights into the function of the intestinal barrier and its response to bacterial invasion in microgravity. Experiments will be conducted on the International Space Station and on earth.

Under a partnership announced In December 2018, **Path BioAnalytics** will produce and test 3D cystic fibrosis organoid models from primary human bronchial and nasal epithelial cells using **InSphero's** 3D cell-based technology.

In January, **Irvine Scientific** changed its US name to **FUJIFILM Irvine Scientific**.

Product Introductions

Polyplus-transfection introduced in November 2018 jetOPTIMUS, new reagents for nanoparticle DNA transfection. It is designed to be primarily used for research purposes across academic research in mammalian cells,

especially hard-to-transfect cells.

In December 2018, **INDIGO Biosciences** released Expression Profiling of Clinically Relevant CYPs Utilizing upcyte Hepatocytes, a gene expression assay kit featuring human donor-derived hepatocytes.

In January, **FUJIFILM Cellular Dynamics** launched the iCell Microglia iPSCs. To develop iCell Microglia, FUJIFILM entered into an exclusive patent license agreement with the **University of California, Irvine**.

iSpecimen introduced in January fresh primary hematopoietic cells from bone marrow and peripheral (circulating) blood to its iSpecimen Marketplace.

In January, **STEMCELL Technologies** released mTeSR Plus, an enhanced version of mTeSR1 feeder-free hPSC-maintenance medium, featuring stabilization enhancements.

Protein-based Analysis

Company Announcements

In December 2018, antibody provider **Proteintech** and **BenchSci** partnered. BenchSci will use machine learning to identify published data for Proteintech's catalog in open- and closed-access datasets, display related published figures and allow researchers to search by experimental variables.

Active Motif partnered with **Benchsci** in January. Using machine learning, BenchSci will identify published data for Active Motif's products in open- and closed-access datasets, display published and vendor-provided validation figures, and allow researchers to search using experimental variables.

Qlucore partnered with **Cambridge Protein Arrays** in December 2018, combining their respective protein arrays and Qlucore Omics Explorer software.

In December 2018, **Abcam** named Giles Kerr to its Board. He previously served as finance director of **Oxford University**.

Abcam pre-announced in January first-half sales ending December 31, 2018, increased 11%, or 10% in constant currency. Antibody, Immunoassay and Customer Engagement: Transactional NPS sales rose 20%, 27% and 64%, respectively. Catalogue sales grew 11%, or 10% in constant currency, while Custom Products and Licensing sales grew 5%, or 2% in constant currency, to make up 6% of total revenues.

Abcam announced in January a research collaboration with **Loulou Foundation**, a private UK-based foundation dedicated to the development of therapeutics for CDKL5 Deficiency Disorder. Loulou Foundation will work closely with Abcam to generate novel rabbit monoclonal antibody reagents for detection of CDKL5 and its downstream kinase phosphorylation targets.

deCODE genetics, an **Amgen** subsidiary, and **SomaLogic** announced in December 2018 the combination of deCODE's data sets with SomaLogic's leading protein measurement capabilities. SomaLogic will analyze up to 40,000 deCODE samples with the its SOMAscan assay.

In January, **AYOXXA Biosystems** signed a research agreement with one of the leading pharmaceutical companies for the development of a series of low-volume, high-sensitivity multiplex protein assays intended to validate protein biomarkers in the field of ophthalmology.

In January, **Expedeon** signed a supply and license agreement with **Cell Guidance Systems**, a developer of therapeutic products for medicine and life science research, for use of its Lightning-Link Rapid Biotin technology in the development and production of a TRIFic (Time Resolved Immunofluorescence Exosome Detection Assay) immunoassay.

Product Introductions

In December 2018, **Bio-Techne** introduced the Tocris Bioscience-branded Y27632 (ROCK inhibitor) and CHIR

99021 stem cell compounds.

In January, **Bio-Techne** announced the launch of its cell and gene therapy portfolio, which includes GMP cytokines and growth factors, GMP small molecules, GMP media, and high-quality antibodies for flow cytometry and immunocytochemical characterization.

Hypha Discovery released in January the PolyCYPs kit, a scalable, easy-to-use oxidative catalytic technology. The platform enables the synthesis of CYP P450-derived human and other mammalian metabolites, as well as novel hydroxylated derivatives.

Sequencing

Company Announcements

Samplix, whose Xdrop technology is designed for partitioning single molecules in droplets, received a **European Commission Horizon 2020**—SME (small and medium enterprises) Instrument program grant totaling €1.9 million (\$2.2 million).

Roswell Biotechnologies closed a \$32 million Series A round, which will be utilized to develop its DNA sequencing Molecular Electronics technology. The company aims to develop a \$100, one hour, clinical-grade genome.

In January, clinical genomics informatics firm **PierianDx** entered into a strategic, multiyear partnership with **Illumina** to provide a variant interpretation and reporting solution based on its Clinical Genomics Workspace platform and Clinical Genomics Knowledgebase for select Illumina oncology products. Illumina and its affiliates will be responsible for the distribution of the RUO oncology products and packaged solutions. Laboratories that purchase the RUO products from Illumina will have an option to receive standardized reporting from PierianDx, driven by professional guidelines for streamlined case review and sign-out.

In January, **Color** announced that **Illumina** will provide sequencing reagents and hardware to its initiative to build the foundation for the first mainstream application of whole-genome sequencing in clinical care through the use of polygenic risk scores. The initiative aims to enroll 100,000 volunteers.

In January, the **US FDA** granted **Illumina** Breakthrough Device Designation for its TruSight Oncology Comprehensive, an assay based on the content of TruSight Oncology 500, which is designed to detect known and emerging solid tumor biomarkers. As a result, the assay will receive prioritized review and resources. Illumina is seeking FDA approval of the assay as a companion diagnostic.

On its fourth quarter 2018 earnings call, **Illumina** announced that it is lowering the price of its NovaSeq S1 and S2 NovaSeq flow cells by 25% and 10%, respectively. The company also announced a partnership with **Sysmex** to sell what it called the first NGS-based oncology panel in Japan. The company also announced that its NextSeq 550Dx sequencer received product approval certification with the **Pharmaceuticals and Medical Devices Agency** in Japan, Illumina's first such designation in the country.

In January, **SOPHiA GENETICS** closed a \$77 million round, led by **Generation Investment Management**, bringing the total raised to \$140 million.

In January, **LifeMap Sciences**, a subsidiary of **AgeX Therapeutics**, announced a partnership with **Tianjin Novogene Medical Laboratory** and **Shanghai Shanyi** to provide a combined, best-of-breed clinical NGS analysis and interpretation platform for Tianjin Novogene Medical Laboratory's customers in China. LifeMap Sciences' TGex is the leading provider of tertiary NGS analysis and interpretation solutions for rare pediatric disorders in the Chinese market.

Paragon Genomics partnered with **MGI Tech**, a subsidiary of **BGI Group**, which will distribute Paragon Genomics' CleanPlex NGS Panels for use with MGI's sequencing platforms. Paragon Genomics will distribute MGI's automated sample preparation workstation systems in the US and Canada. Paragon Genomics also joined the MGI

Compatible Partner Program as a compatible/certified partner.

In January, **MGI** announced pricing and its first early access customer for the new ultra-high-throughput MGISEQ-T7 sequencer, which sells for \$1 million, stating that it has driven down sequencing cost to \$5 per gigabyte. The company also announced that the MGI global sequencer user program, which supports collaborators using the T7, signed up **WeGene**, direct-to-consumer genetics testing provider based in China, as the first user.

MGI announced in January that it delivered over 1,000 sequencers to more than 250 users in 16 countries as of the end of last year. Its number of employees now totals 800.

Genomenon completed a \$2.5 million equity financing round in January. Genomenon connects patient DNA with evidence found in scientific literature.

In January, **NRGene** and **Toyota** announced the decoding of a leading commercial strawberry genome. The combination of NRGene's assembly of the strawberry genome and Toyota's GRAS-Di DNA analysis technology will enhance the development of natural strawberry varieties better suited to the Japanese market.

Arbor Biosciences, which provides NGS target enrichment and synthetic biology products, partnered with the **International Wheat Genome Sequencing Consortium** in January. The strategic partnership will provide Consortium members with a standardized exome panel for R&D, as well as expand Arbor's collaboratively developed myBaits Expert panels in agrigenomics.

In January, **HTG Diagnostics** announced that CEO TJ Johnson will assume the role of executive chairman of the Board and be replaced by President and COO John Lubniewski.

In January, **seqWell** and **Gencove** partnered to combine their respective plexWell library preparation technology, and imputation and analysis software for low-pass whole-genome sequencing and genotype imputation.

Product Introductions

HTG Molecular Diagnostics introduced in June the HTG EdgeSeq Reveal, a software that streamlines analysis of biomarker data from samples analyzed with the HTG EdgeSeq Precision Immuno-Oncology Panel on its EdgeSeq system.

In January, **Swift Biosciences** launched the Swift Amplicon 16S+ITS Panel, facilitating routine NGS analysis of complex microbial samples (e.g. bacteria, archaea, fungi) using a single, multiplexed primer pool targeting the 16S rRNA gene (all variable regions, V1-V9) and ITS1 and ITS2 for fungi.

In January, **Oxford Nanopore** announced that its PromethION 24 and PromethION 48 are now available in its nanopore store. The modular systems include a computer module for real-time base calling and onward analysis.

Bioprocess Analysis

Company Announcements

In November 2018, by mutual accord, **Lonza** and **Sartorius Stedim Biotech** (SSB) modified their agreement that had given SSB exclusive sales and marketing rights for certain media and buffers developed by Lonza for use in biopharmaceutical manufacturing processes. Under the new agreement, SSB continues to offer Lonza media and buffers on a nonexclusive basis, and Lonza Pharma & Biotech resumes sales and marketing of all its media products for both manufacturing and research. Also, under the new agreement, SSB will be a preferred supplier for specific Lonza projects.

In January, **Sartorius** joined the **National Institute for Innovation in Manufacturing Biopharmaceuticals** in Delaware, a public-private partnership whose members include 71 academic institutions and 44 companies.

Thermo Fisher Scientific opened its first Bioprocess Design Center in Shanghai, China, in November 2018. The 29,063 ft² (2,700 m²) facility houses bioprocessing analytical technologies and equipment in an environment suitable for end-to-end process development.

In December 2018, **Pall** opened its Biotech Integrated Solutions Center of Excellence (CoE) in Shanghai, China, for bioprocess engineering consultancy, technology demonstration, testing and training. CoE facilities currently exist in Portsmouth, UK, Westborough, US, and Shanghai, with plans for a new European facility.

Product Introductions

In November, **Merck KGaA Life Science** launched its new BioContinuum Platform for continuous processing, including the expanded Pellicon Single-Pass Tangential Flow Filtration system.

In January, **Sartorius Stedim Biotech** released the BIOSTAT RM TX single-use bioreactor, a new wave-mixed system developed specifically for closed, automated expansion of consistent quality cell products. It consists of an automated control unit and a up to two rocking platforms to agitate single-use Flexsafe RM TX bags (up to 5 L working volume). The bags include single-use sensors for pH, DO and viable biomass that are integrated in the BIOSTAT B control unit. With culture volumes greater than 500 mL, on-line analysis of viable biomass is also possible by connecting the single-use BioPAT ViaMass sensor.

Process Analysis

Company Announcements

In November 2018, **Endress+Hauser** opened a €3 million (\$3 million), 29.063 ft² (2,700 m²) calibration and training center in Jubail, Saudi Arabia, calling it the only vendor-managed gravimetric calibration facility in the region. The company currently has 50 employees in Saudi Arabia.

AMETEK Land named **Focal-Point Technology** as a UK distributor for its combustion and emissions monitors, and as a global partner for its FGA 900 compact flue gas analyzers.

In January, photonic solutions firm **Excelitas Technologies** acquired **Axsun Technologies**, a developer of MEMs-based light engines for medical imaging and industrial spectroscopy applications, from **Anzu Partners**.

Product Introductions

In November 2018, **LABWit** released the ZWYF-290A smart OD online measuring shaking bioreactor for cell growth, and the ZWYB-292 pH automatic pulse feeding shaking bioreactor. The ZWYF-290A features noninvasive optical density measurements of micro-organism cells in the shaking flasks.

Barben Analytical, a unit of **AMETEK Thermal Process Management**, introduced in January the OXYvisor, its second generation process oxygen analyzer, which optically measures oxygen in either the gas or liquid phase and features trace level ppm oxygen gas-phase measurements.

Reported Financial Results

\$ in Millions USD	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Corning	Q4	31-Dec	\$3,035.0	15.1%	\$464.0	26.1%	\$292.0	NM
Corning	FYE	31-Dec	\$11,290.0	11.6%	\$1,575.0	-2.1%	\$1,066.0	NM
Corning (Life Sciences)	Q4	31-Dec	\$238.0	5.8%	\$37.0	23.3%	\$29.0	20.8%
Corning (Life Sciences)	FYE	31-Dec	\$946.0	7.6%	\$148.0	23.3%	\$117.0	23.2%
Danaher	Q4	31-Dec	\$5,363.5	5.5%	\$962.6	2.7%	\$746.8	-12.8%
Danaher	FYE	31-Dec	\$19,893.0	8.5%	\$3,403.8	13.8%	\$2,650.9	6.4%
Danaher (Life Sciences)	Q4	31-Dec	\$1,793.5	10.4%	\$353.7	9.1%	NA	NA
Danaher (Life Sciences)	FYE	31-Dec	\$6,471.4	13.3%	\$1,229.3	22.4%	NA	NA
Danaher (Environmental & Applied Solutions)	Q4	31-Dec	\$1,126.5	4.5%	\$4,319.5	8.8%	NA	NA
Danaher (Environmental & Applied Solutions)	FYE	31-Dec	\$4,319.5	8.8%	\$988.0	8.0%	NA	NA
Illumina	Q4	31-Dec	\$867.0	11.4%	\$197.0	-14.3%	\$210.0	208.8%
Illumina	FYE	31-Dec	\$3,333.0	21.1%	\$883.0	45.7%	\$826.0	13.8%
Meridian Bioscience*	Q1	31-Dec	\$51.5	-1.5%	\$10.6	30.9%	\$8.1	28.6%
Meridian Bioscience (Life Sciences)*	Q1	31-Dec	\$14.8	0.1%	\$5.1	74.3%	NA	NA
PerkinElmer	Q4	31-Dec	\$756.3	17.9%	\$115.7	23.6%	\$71.3	NM
PerkinElmer	FYE	31-Dec	\$2,778.0	23.1%	\$323.9	9.6%	\$237.9	-18.7%
PerkinElmer (Discovery and Analytical Solutions)	Q4	31-Dec	\$459.9	2.6%	\$92.7	-0.7%	NA	NA
PerkinElmer (Discovery and Analytical Solutions)	FYE	31-Dec	\$1,693.2	7.3%	\$295.0	9.5%	NA	NA
PerkinElmer (Diagnostics)	Q4	31-Dec	\$296.6	53.2%	\$85.8	45.8%	NA	NA
PerkinElmer (Diagnostics)	FYE	31-Dec	\$1,085.5	59.8%	\$291.9	40.6%	NA	NA
Teledyne Technologies	Q4	31-Dec	\$748.4	6.2%	\$111.2	17.5%	\$91.1	34.8%
Teledyne Technologies	FYE	31-Dec	\$2,901.8	11.4%	\$416.6	29.5%	\$333.8	46.9%
Teledyne Technologies (Instrumentation)	Q4	31-Dec	\$263.4	3.4%	\$43.0	40.1%	NA	NA
Teledyne Technologies (Instrumentation)	FYE	31-Dec	\$1,021.2	7.1%	\$147.4	17.0%	NA	NA
Thermo Fisher Scientific	Q4	31-Dec	\$6,507.0	7.6%	\$1,148.0	20.0%	\$898.0	70.1%
Thermo Fisher Scientific	FYE	31-Dec	\$24,358.0	16.4%	\$3,783.0	27.8%	\$2,938.0	32.0%
Thermo Fisher Scientific (Analy. Tech)	Q4	31-Dec	\$1,568.0	10.9%	\$416.0	20.2%	NA	NA
Thermo Fisher Scientific (Analy. Tech)	FYE	31-Dec	\$5,469.0	13.4%	\$1,247.0	21.4%	NA	NA
Thermo Fisher Scientific (Lab Prod.)	Q4	31-Dec	\$2,602.0	8.4%	\$342.0	14.0%	NA	NA
Thermo Fisher Scientific (Lab Prod.)	FYE	31-Dec	\$10,035.0	28.2%	\$1,258.0	25.3%	NA	NA
Thermo Fisher Scientific (Spec. Diag.)	Q4	31-Dec	\$951.0	4.0%	\$233.0	-3.7%	NA	NA
Thermo Fisher Scientific (Spec. Diag.)	FYE	31-Dec	\$3,724.0	6.8%	\$952.0	2.7%	NA	NA
Xylem	Q4	31-Dec	\$1,383.0	8.3%	\$194.0	9.6%	\$225.0	216.9%
Xylem	FYE	31-Dec	\$5,207.0	10.6%	\$654.0	18.5%	\$549.0	65.9%
Xylem (Water Infrastructure)	Q4	31-Dec	\$584.0	3.2%	\$119.0	12.3%	NA	NA
Xylem (Water Infrastructure)	FYE	31-Dec	\$609.0	4.5%	\$359.0	15.1%	NA	NA
Waters	Q4	31-Dec	\$715.0	4.0%	\$244.5	6.1%	\$185.2	NM
Waters	FYE	31-Dec	\$2,419.9	4.8%	\$739.8	11.7%	\$593.8	2823.5%
Other Currencies (in Millions)								
Hitachi High-Technologies****	Q3	31-Dec	¥540.5	9.0%	¥51.4	33.0%	¥36.6	24.6%
Porvair***	FYE	30-Nov	£128.8	10.7%	£12.9	4.3%	£10.0	13.4%
Porvair (Laboratory)***	FYE	30-Nov	£38.7	9.6%	£6.2	1.6%	NA	NA
Precision System Science**	Q1	30-Sep	¥0.9	17.5%	¥0.001	99.2%	¥0.9	NM
Sartorius	FYE	31-Dec	€ 1.6	11.5%	€ 0.41	14.7%	€ 0.18	21.5%
Sartorius (Bioprocess Solutions)	FYE	31-Dec	€ 1.1	13.2%	€ 0.33	15.6%	NA	NA
Sartorius (Lab Products and Services)	FYE	31-Dec	€ 0.4	7.4%	€ 0.08	11.4%	NA	NA

*=For fiscal year ending September 30, 2019

**For fiscal year ending June 30, 2019

***For fiscal year ending November 30, 2018

****For fiscal year ending March 31, 2019

NA = not available, NM = not material

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