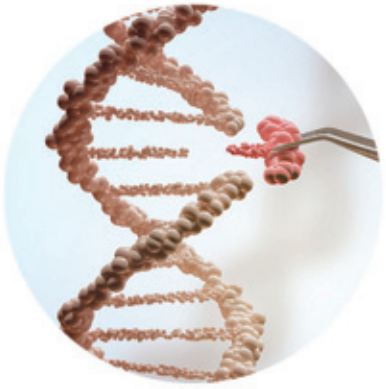
REPLIGEN

INSPIRING ADVANCES IN BIOPROCESSING

2019 ANNUAL REPORT



DRIVING GROWTH


IMPROVING
LIVES
THROUGH
INNOVATION
IN
BIOPROCESSING

Through the commitment of our team of now over 760 individuals worldwide, Repligen continues to deliver innovative technologies that positively impact biological drug production. We again reported strong performance in 2019, and we carry into 2020 our culture of innovation, quality and responsibility to best serve our employees, customers, shareholders and communities – ultimately improving the lives of patients benefitting from remarkable advances in biological drug development.


$270
million in
reported revenue
OPUS 8

Business Highlights 2019

revenue growth in 2019, including 33% organic	**39%**
of total revenue from "new" class of biologics - cell & gene therapies	**15%**
acquisition of process analytics innovator C Technologies	**Analytics**
increase in adjusted fully diluted EPS	**62%**
dollars in cash and cash equivalents at year end 2019	**528M**
new technology launch for fed-batch harvest clarification	**TFDF®**
square foot increase in combined sites size, to 390,000 square feet	**67K**
Repligen employees worldwide, from 548	**761**

Tony J. Hunt
President and Chief
Executive Officer

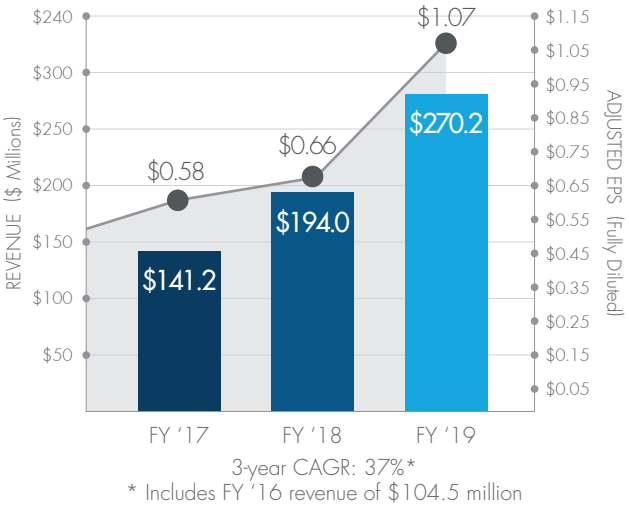
To Our Shareholders

In 2019, we saw acceleration in demand for our bioprocessing products, completed a key acquisition and expanded our production capacity and systems to support future growth.

I'm very pleased to report on another excellent year of accomplishment at Repligen, where we met and exceeded our financial, strategic and operational goals. Accelerating demand for our bioprocessing products drove revenue growth of 39% and a 62% increase in adjusted earnings per share. We expanded our manufacturing capacity in the U.S. to stay ahead of increasing demand as the global markets for biological medicines – including the rapidly emerging class of cell and gene therapies – remained robust. Throughout the year, our team continued to execute on our long-term growth strategy with M&A and R&D at the core of our success. We welcomed the C Technologies team to Repligen through our acquisition of this process analytics innovator, adding an exciting new vertical to our direct-to-customer business. Staying true to our course of creating and leading new markets through technology innovation, we also launched impactful new products, "inspiring advances in bioprocessing."

Strong Financial Performance

We delivered 39% overall and 33% organic revenue growth in 2019, and a 62% increase in adjusted earnings per share, with 3-year revenue CAGR of 37%.



Growth Drivers

Looking back at the year, there were five key drivers of organic growth:

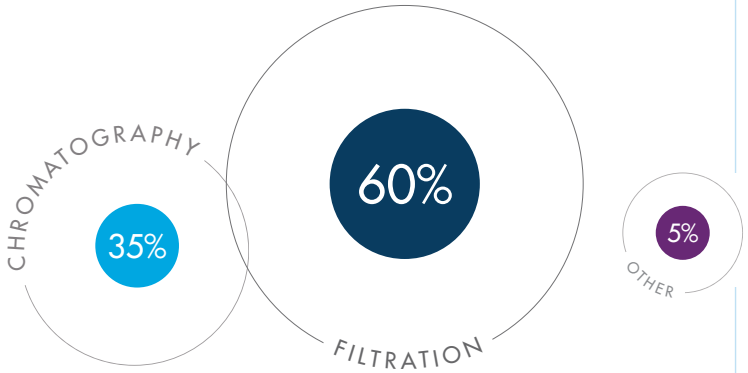
1 Strong adoption at gene therapy accounts

Our focus in gene therapy is on delivering yield and efficiency improvements in viral vector manufacturing. Gene therapy has rapidly emerged as a new class of biologics, representing approximately 15% of our 2019 revenue, with Filtration products accounting for approximately 60% and Chromatography products accounting for approximately 35% of sales into these accounts. With a strong base of core customers and differentiated technology, we are well positioned for continued success in the gene therapy sector.

> $41 Million

Cell and Gene Therapy Growth

*In 2019, revenue from gene therapy customers nearly doubled, to account for over **$41 million dollars** - approximately 15% of total revenue.*



2 Expanding applications for XCell ATF® beyond perfusion

We increased our market share for XCell ATF in upstream continuous processing (perfusion) and successfully introduced ATF products into the seed train of fed-batch processes. The purpose of a seed train is to generate an adequate number of cells for the inoculation of a production bioreactor; a time and cost intensive process involving multiple inoculum bioreactors of increasing size. Use of XCell ATF intensifies this cell culture process, enabling customers to remove inoculum bioreactor steps, and shorten the time to the production bioreactor. The expanded use of ATF was a key growth driver for our Filtration franchise in 2019 and a catalyst for sustained long term growth.

DIVERSIFYING

3 Significant uptake of our TFF systems portfolio

During the year, we focused our efforts on tying tangential flow filtration (TFF) equipment with consumables, providing a "systems" solution for targeted upstream and downstream applications. We established a core team purposed with building out systems for our TFF portfolio. Not only has this team delivered on providing systems for fed-batch ultrafiltration and diafiltration (UF/DF) applications in downstream applications, but they have also delivered on the development and launch of our KrosFlo® TFDF™ (tangential flow depth filtration) technology; a first-to-industry innovation for upstream harvest clarification. We look forward to seeing increased traction of KrosFlo Systems in the marketplace, with the goal of providing our customers with the most appropriate and impactful solution for their process.

4 Accelerated adoption of our OPUS® pre-packed columns

Our CDMO and biopharmaceutical customers continued to scale and expand their use of OPUS pre-packed columns (PPCs) used in downstream purification processes. With OPUS as the leading technology in the PPC market, combined with new demand for OPUS in gene therapy accounts, we delivered approximately 1,400 columns to our customer base in 2019, up from approximately 700 in 2018. To ensure our ability to stay ahead of demand, we made significant investments in 2019, and here again in 2020, to expand our capacity and resources in OPUS production.

5 Overall strength of the biologics market

In the U.S. alone, 10 new monoclonal antibodies and two gene therapy drugs were approved by the U.S. Food and Drug Administration in 2019. With a rich pipeline of over 1,000 biological drug candidates, expectations are high for strong growth in the years ahead.

Realizing Our Vision

We have done an excellent job establishing Repligen as a best-in-class bioprocessing company over the past six years. We've added depth and breadth to the organization, including our product portfolio, which in 2019 alone saw the addition of KrosFlo TFDF Systems, and through our acquisition of C Technologies' SoloVPE® and FlowVPE® devices. We're proud to be the company behind OPUS columns, single-use XCell ATF, NGL-Impact® protein A ligands and many more industry firsts. We have firmly established ourselves as a trusted partner and innovator, known to deliver solutions for specific challenges that our customers face in the biologics manufacturing process.

Our commercial team continues to grow and expand and we now have 140 talented individuals (internal and external) focused on supporting and expanding our customer base. We have entered new markets, in particular cell and gene therapy, where the need to scale and optimize manufacturing processes with a focus on yield is a key pain point in this industry. We have invested in capacity to ensure excellence in delivery of product and service to our customers, and in systems to ensure our internal operations are dynamic and secure. We remain passionate and invested in innovation; developing new products to complement many of the leading technologies we have in the market today.

Performance Against Our 2019 Goals

Entering 2019, we defined clear strategic priorities around overall market traction, new product introductions, acquisitions and manufacturing capacity expansion to allow us to achieve our financial goals. I am proud to say that our team delivered exceptionally well on these objectives.

All franchises accelerated in 2019

Filtration:

In 2019, our Filtration franchise remained our largest, generating $119.5 million in revenue, which represented 33% year-over-year organic growth and 44% of overall revenue. Our XCell ATF product line had a record year, with single-use sales increasing by 45%, and we also saw 30%-plus growth in sales of our Spectrum® hollow fiber filtration products and KrosFlo systems, as well as our TangenX® SIUS® flat sheet TFF products.

Proteins:

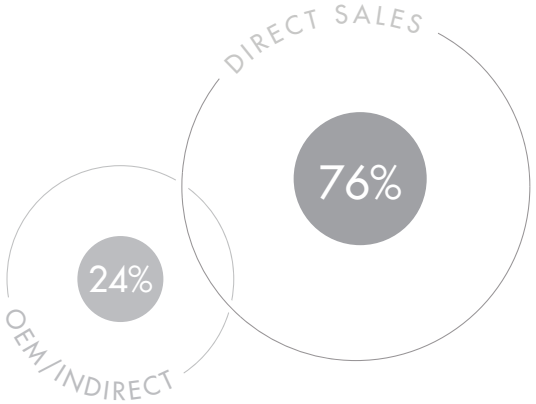
Our Proteins franchise outpaced our expectations in 2019, generating $65.0 million in revenue, which represented 24% organic growth and 24% of total revenue. We saw strong demand for growth factors during the year and double-digit growth in Protein A ligands. As we move into 2020, we are prepared for Cytiva (formerly GE Healthcare Life Sciences) to transition a portion of their demand to in-house manufacturing. Partially offsetting any resulting headwind in 2020, we expect continued strength in our growth factors business, and look forward to seeing how our NGL-Impact® A ligand gains momentum in the marketplace through our collaboration with Purolite, as customers adopt their high-performance resins.

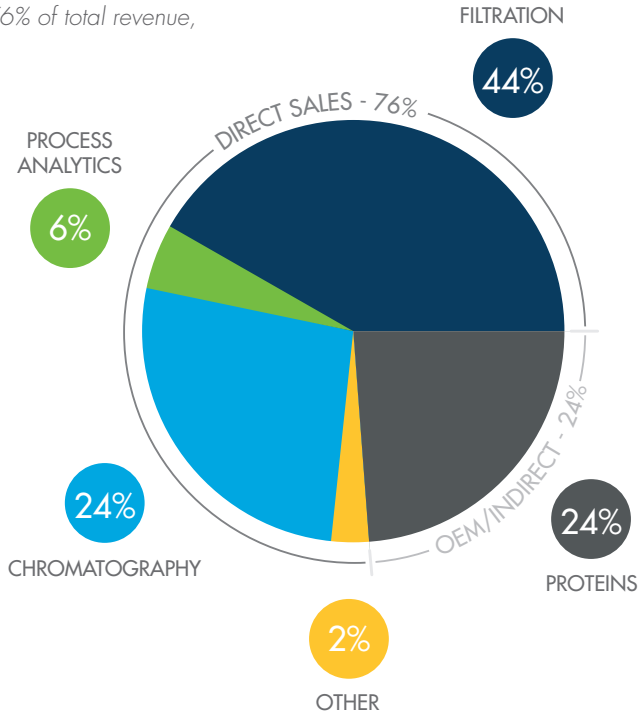
Chromatography:

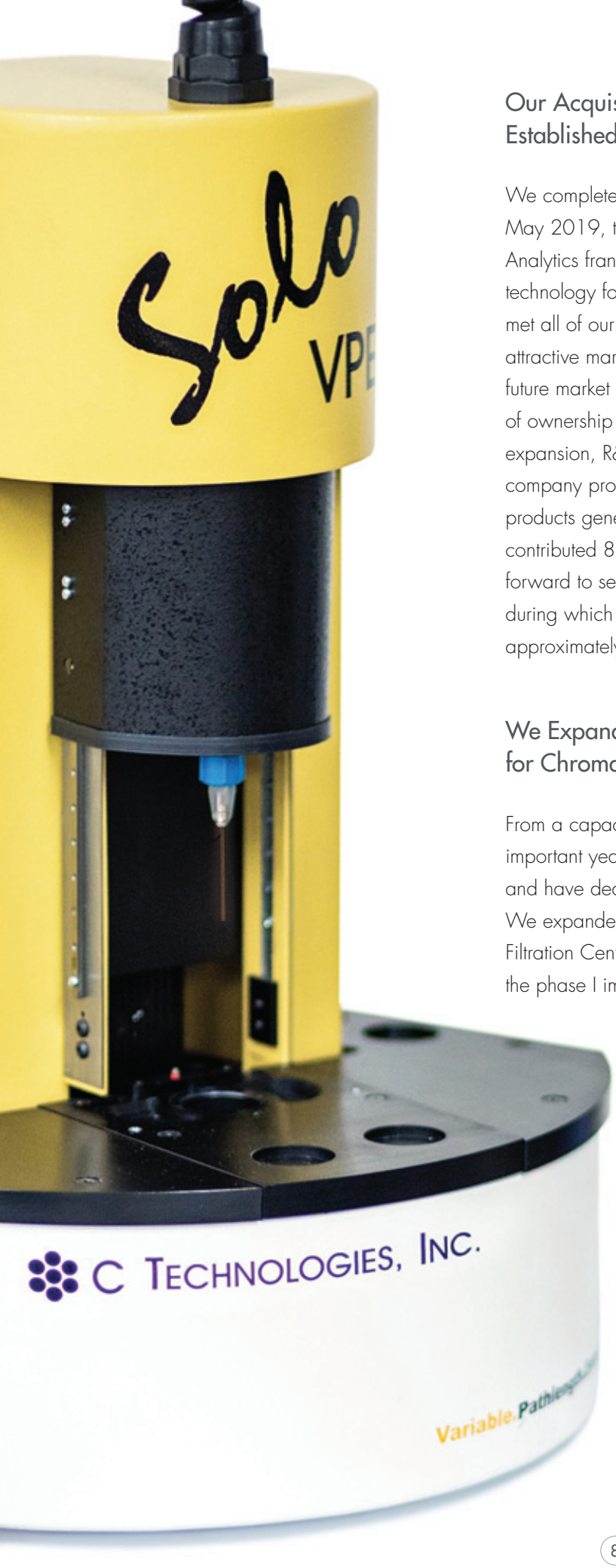
Our Chromatography business generated $64.6 million in revenue, which represented 43% organic growth and 24% of overall revenue. Sales of OPUS PPC were up over 50% year-over-year, fueled by scale-ups at existing accounts as well as new demand from cell and gene therapy customers, which accounted for over 25% of OPUS revenue. With unit volume doubling in 2019, to 1,400 OPUS columns, we increased our production capacity five-fold, adding five new production suites in Waltham and we plan to continue to expand our production capabilities through 2020 and 2021.

Achieving Our Goals

In 2019, we saw adoption of our Chromatography and Filtration products continue to accelerate, bringing our direct sales to 76% of total revenue, up from 72% in 2018 and 62% in 2017.







Our Acquisition of C Technologies Established a Process Analytics Franchise

We completed the acquisition of C Technologies at the end of May 2019, taking a major step forward in establishing a Process Analytics franchise with foundational VPE Slope Spectroscopy® technology for protein concentration measurement. C Technologies met all of our acquisition criteria, including differentiated technology, attractive margins, near term accretion, and opportunities for future market and technology expansion. During our seven months of ownership in 2019, we focused our efforts on commercial expansion, R&D project prioritization and implementation of public company processes. In line with our expectations, C Technologies' products generated $16.4 million of incremental revenue and contributed 8 points of our 39% growth for the year. We look forward to seeing the impact of the new commercial team in 2020, during which we expect the Process Analytics franchise to generate approximately $32 million in revenue.

We Expanded our Manufacturing Capacity for Chromatography and Filtration Systems

From a capacity and infrastructure standpoint, 2019 was an important year for us — we increased our OPUS capacity five-fold and have dedicated programs in place to expand again in 2020. We expanded and centralized manufacturing of XCell ATF at our Filtration Center of Excellence in Marlborough, MA and completed the phase I implementation of SAP.

We Strengthened Our Balance Sheet

During 2019, we raised close to $500 million net through a series of equity and convertible debt financings, putting us in a strong position to act on potential future acquisitions.

INNOVATING

We Introduced KrosFlo TFDF and Advanced Other Key R&D Programs

On the R&D front, the highlight of 2019 was the introduction of KrosFlo TFDF, a revolutionary approach to fed-batch harvest clarification that combines the benefits of tangential flow and depth filtration into one integrated solution. Our technical launch of KrosFlo TFDF in September was enthusiastically received by customers, setting us up for a full commercial launch of benchtop and production scale systems in 2020.

In addition to KrosFlo TFDF, we advanced a number of R&D programs, with our next-generation XCell™ Controller, TangenX™ SIUS™ Gamma and new affinity ligands reaching final stages of product development.

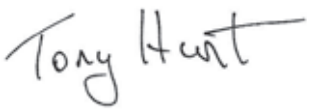
Our 2020 Focus

As we move into 2020, our strategic priorities will center on the following:

- New product launches with a focus on KrosFlo TFDF and XCell ATF controllers;
- Expanding our market presence in harvest clarification applications where we have the best technology to address process efficiency and yield goals;
- Further expanding our market presence in gene therapy driven by our Filtration and Chromatography products;
- Broadening the customer base and applications for our Process Analytics portfolio, specifically SoloVPE and FlowVPE;
- Implementing capacity expansion and operating margin improvement programs;
- Evaluating M&A opportunities to supplement organic growth; and finally,
- Achieving our financial goals for 2020, in line with our most current guidance as updated through the year.

In summary, 2019 was another outstanding year for the company. We believe that the blueprint we have put in place over the last five years around building out a world-class commercial team, bringing disruptive technologies to market and supplementing our technology base with select M&A's will be the catalyst for growth over the coming years. We believe we are well positioned to deliver on another strong year for Repligen in 2020. In closing, I wish to recognize our employees around the globe for their commitment and leadership in 2019. I also want to thank our loyal shareholders and customers for their part in Repligen's success.

Tony J. Hunt



2019

REPLIGEN CORPORATION

FORM 10-K

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2019

OR

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from to

Commission File Number 000-14656

REPLIGEN CORPORATION
(Exact name of registrant as specified in its charter)

Delaware	**04-2729386**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification No.)**
41 Seyon Street, Bldg. 1, Suite 100 Waltham, MA	**02453**
(Address of principal executive offices)	**(Zip Code)**

Registrant's telephone number, including area code: (781) 250-0111

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, par value $0.01 per share	RGEN	The Nasdaq Global Select Market

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☒ No ☐.

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒.

Indicate by checkmark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐.

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐.

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company" and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer ☒	Accelerated filer ☐
Non-accelerated filer ☐	Smaller reporting company ☐
	Emerging growth company ☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. Yes ☐ No ☐.

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act). Yes ☐ No ☒.

The aggregate market value of the voting and non-voting common equity held by non-affiliates as of June 28, 2019, the last business day of the registrant's most recently completed second fiscal quarter, was $3,599,784,849.

The number of shares of the registrant's common stock outstanding as of February 18, 2020 was 52,083,563.

Documents Incorporated By Reference

The registrant intends to file a proxy statement pursuant to Regulation 14A within 120 days of the end of the fiscal year ended December 31, 2019. Portions of such proxy statement are incorporated by reference into Part III of this Annual Report on Form 10-K.

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FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K ("Form 10-K") contains forward-looking statements which are made pursuant to the safe harbor provisions of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended (the "Exchange Act"). The forward-looking statements in this Form 10-K do not constitute guarantees of future performance. Investors are cautioned that express or implied statements in this Form 10-K that are not strictly historical statements, including, without limitation, statements regarding current or future financial performance, potential impairment of future earnings, management's strategy, plans and objectives for future operations or acquisitions, product development and sales, research and development, selling, general and administrative expenditures, intellectual property and adequacy of capital resources and financing plans constitute forward-looking statements. Such forward-looking statements are subject to a number of risks and uncertainties that could cause actual results to differ materially from those anticipated, including, without limitation, the risks identified under the caption "Risk Factors" and other risks detailed in this Form 10-K and our other filings with the Securities and Exchange Commission. We assume no obligation to update any forward-looking information contained in this Form 10-K, except as required by law.

PART I

ITEM 1. BUSINESS

The following discussion of our business contains forward-looking statements that involve risks and uncertainties. When used in this report, the words "intend," "anticipate," "believe," "estimate," "plan" and "expect" and similar expressions as they relate to us are included to identify forward-looking statements. Our actual results could differ materially from those anticipated in these forward-looking statements and are a result of certain factors, including those set forth under "Risk Factors" and elsewhere in this Annual Report on Form 10-K ("Form 10-K").

References throughout this Form 10-K to "Repligen Corporation", "Repligen", "we", "us", "our", or the "Company" refer to Repligen Corporation and its subsidiaries, taken as a whole, unless the context otherwise indicates.

Overview

Repligen Corporation is a global life sciences company that develops and commercializes highly innovative bioprocessing technologies and systems that increase efficiencies and flexibility in the process of manufacturing biological drugs.

As the overall market for biologics continues to grow and expand, our customers – primarily large biopharmaceutical companies and contract development and manufacturing organizations – face critical production cost, capacity, quality and time pressures. Built to address these concerns, our products are helping to set new standards for the way biologics are manufactured. We are committed to inspiring advances in bioprocessing as a trusted partner in the production of critical biologic drugs – including monoclonal antibodies ("mAb"), recombinant proteins, vaccines and gene therapies – that are improving human health worldwide.

We currently operate as one bioprocessing business, with a comprehensive suite of products to serve both upstream and downstream processes in biological drug manufacturing. Building on over 35 years of industry expertise, we have developed a broad and diversified product portfolio that reflects our passion for innovation and the customer-first culture that drives our entire organization. We continue to capitalize on opportunities to maximize the value of our product platform through both organic growth initiatives (internal innovation and commercial leverage) and targeted acquisitions.

Our Products

Our bioprocessing business is comprised of four main franchises, three of which we sell directly to end-users (Chromatography, Filtration and Process Analytics) and one that we sell through supply agreements (Proteins).

Direct-to-Customer Products

Since 2012, we have significantly expanded our direct-to-customer presence through our Chromatography, Filtration and Process Analytics franchises, each of which includes novel and differentiated technologies. We have diversified and grown our direct-to-customer product offering through internal innovation and through strategic, accretive acquisitions of assets or businesses that leverage existing product lines and/or expand our customer and geographic scope.

To support our sales growth goals for these products, we make ongoing investments in our commercial organization, our research and development ("R&D") team and our manufacturing capacity. Our commercial and R&D teams work together to develop and launch new products and applications that address specific biomanufacturing challenges, and to build new markets for acquired technologies. We have six key manufacturing sites across the United States, Sweden and Germany, with additional capacity being added by the end of 2020 in the Netherlands. We regularly evaluate and invest in capacity as needed to ensure timely deliveries and to stay ahead of increased customer demand for our products.

A substantial piece of our revenue comes from consumable and/or single-campaign ("single-use") products as compared to associated equipment. The customization, scalability and plug-and-play convenience of consumable and/or single-use products, and in many cases the closed nature of our technologies, make them ideal for use in biologics manufacturing processes where contamination risk is a critical concern of our customers.

Chromatography

Our Chromatography franchise includes a number of products used in downstream purification, development, manufacturing and quality control of biological drugs. The main driver of growth in this portfolio is our OPUS® Column product line.

Additional chromatography products include our affinity capture resins, such as CaptivA® Protein A Resins, that are used in a small number of commercial drug processes and our ELISA test kits, used by quality control departments to detect and measure the presence of leached Protein A and/or growth factor in the final product.

OPUS Pre-Packed Columns

Our Chromatography franchise features a wide range of OPUS columns, which we deliver to our customers sealed and pre-packed with their choice of resin. These are single-use or multiple-use disposable columns that replace the use of customer-packed glass columns used in downstream purification processes. By designing OPUS columns to be a technologically advanced and flexible option for the purification of biologics from process development through clinical and commercial-scale manufacturing, Repligen has become a leader in the pre-packed column ("PPC") market. Our biomanufacturing customers value the significant cost savings that OPUS columns deliver by reducing set up time, labor, equipment and facility costs – in addition to delivering product consistency and "plug and play" convenience.

We launched our first production-scale OPUS columns in 2012 and have since added larger diameter options that scale up to use with 2,000 liter bioreactors. Our OPUS 80R column is the largest available PPC on the market for use in late-stage clinical or commercial purification processes. We have also introduced next-generation features such as a resin recovery port on our larger columns, which allows our customers to remove and reuse the recovered resin in other applications. We believe the OPUS 5-80R product line is the most flexible and platformable PPC product offered in the marketplace today, and is serving the purification needs of customers manufacturing monoclonal antibodies ("mAb") and other biologics such as cell and gene therapies ("C&GT").

In addition to our larger scale OPUS columns, our portfolio includes our smaller-scale OPUS columns, including specifically RoboColumn®, MiniChrom™ and ValiChrom™ columns for process development and validation. These columns are used in high-throughput process development screening, viral clearance validation studies and scale down validation of chromatography processes.

We maintain customer-facing centers in both the United States and Europe for OPUS columns, and offer our customers an unmatched ability to pack any of over 100 resins in our OPUS 5-80R range and any of over 300 resin choices in our small-scale OPUS columns.

Other Chromatography

Our Chromatography portfolio also includes ELISA kits, which are analytical test kits to quantitate the proteins and growth factors, and chromatography resins, including our CaptivA brand.

Filtration

XCell ATF™ Cell Retention Systems

Our Filtration products offer a number of advantages to manufacturers of biologic drugs and are used in development, clinical and commercial-scale production. We first moved into Filtration technology with our

acquisition of XCell Alternating Tangential Flow ("ATF") assets from Refine Technology ("Refine") in 2014. XCell ATF systems are used primarily in upstream perfusion (continuous) cell culture processing.

XCell ATF is a cell retention technology. The system is comprised of an advanced hollow fiber ("HF") filtration device, a low shear pump and a controller. The XCell ATF system is connected to a bioreactor and enables the cell culture to be run continuously, with cells being retained in the bioreactor, fresh nutrients (cell culture media) being fed into the reactor continuously and clarified biological product and cell waste being removed continuously. The cells are maintained in a consistent nutrient-rich environment and can reach cell densities two- and three-times higher than those achieved by standard fed-batch culture. By continuously removing waste products from the fermenter, the XCell ATF systems routinely increases cell densities to two- or three-times the levels achieved by standard fed-batch culture. As a result, product yield is increased, which improves facility utilization and can reduce the size of a bioreactor required to manufacture a given volume of biologic drug product. XCell ATF systems are available in a wide range of sizes that can easily scale from laboratory use through full production with bioreactors as large as 5,000 liters.

Through internal innovation, we developed and launched single-use formats of the original stainless steel XCell ATF devices to address increasing industry demand for single-use sterile systems with "plug-and-play" technology. The XCell ATF device is now available to customers in both its original configuration (steel housing and single-use filters) in all sizes (2, 4, 6 and 10), and/or as a single-use device (disposable housing/filter combination) in most sizes (2, 6, and 10). The availability of XCell ATF technology in a single-use format eliminates the time intensive workflow associated with autoclaving, leading to an 80% reduction in implementation speed. The single-use format also enables our customers to accelerate evaluations of the product with a lower initial overall cost of ownership.

In September 2018, we entered into a collaboration agreement with industry leader Sartorius Stedim Biotech ("SSB") to integrate our XCell ATF controller technology into SSB's BIOSTAT® STR large-scale, single-use bioreactors, to create novel perfusion-enabled bioreactors.

TangenX™ Flat Sheet Cassettes

In December 2016, we acquired TangenX™ Technology Corporation ("TangenX"), balancing our upstream XCell ATF systems with a portfolio of flat-sheet tangential flow filtration ("TFF") cassettes used in downstream biologic drug concentration and formulation processes. The TangenX product portfolio includes our single-use SIUS™ brand, providing customers with a high-performance, cost saving alternative to reusable TFF cassettes.

TFF is a rapid and efficient method for the concentration and formulation of biomolecules that is widely used in many applications in biopharmaceutical development and manufacturing. SIUS cassettes are the only purpose built single-use TFF cassettes on the market. The cassette features a high performing membrane and unique cartridge construction that enables a lower price point. Each disposable cassette is delivered pre-sanitized and ready to be equilibrated and used for tangential flow, ultrafiltration and diafiltration applications. Use of SIUS TFF cassettes eliminates non-value added steps of cleaning, testing between uses, storage and flushing required in reusable TFF products, providing cost and time savings. The cassettes are interchangeable with filter hardware from multiple manufacturers, simplifying customer trial and adoption of SIUS products.

Spectrum® Hollow Fibers

We acquired Spectrum Life Sciences LLC ("Spectrum") and its subsidiaries in August 2017 to strengthen our filtration business with the addition of a leading portfolio of HF filtration solutions, including fully integrated KrosFlo® TFF Systems with Konduit sensing and ProConnex® Flow Path single-use assemblies. KrosFlo family of TFF systems for product concentration is fully scalable from 2 milliliters to 5,000 liters – from lab-scale to commercial manufacturing. Designed for purification and formulation applications, KrosFlo Systems enable robust downstream ultrafiltration and microfiltration.

We also gained the Spectra/Por® portfolio of laboratory and process dialysis products and in 2019, we launched the SpectraFlo™ Dynamic Dialysis Systems. Also, in 2019 we introduced the KrosFlo® TFDF™ (Tangential Flow Depth Filtration) Systems, which we believe have the potential to disrupt and displace traditional harvest clarification operations. The KrosFlo TFDF system includes control hardware, novel high throughput tubular depth filters and ProConnex single-use TFDF flow paths. When used for cell culture clarification, single-use KrosFlo TFDF technology delivers unprecedented high flux (>1,000 LMH), high capacity, low turbidity, and minimal dilution, making the technology a high-performance alternative to traditional centrifugation and depth filtration approaches to harvest clarification. TFDF technology also provides benefits such as low hold-up volume, high recovery, small footprint, simple set up and disposal, scalability and reduced process time.

The Spectrum product line of HF filters is used in bench-top through commercial-scale processes, primarily for the filtration, purification and concentration of biologics and diagnostic products. Our KrosFlo filtration systems and equipment offer both standard and customized solutions to bioprocessing customers, with particular strength in consumable and single-use offerings.

With the acquisition of Spectrum, we substantially increased our direct sales presence in Europe and Asia, and we diversified our end markets to include all biologic classes, including mAb, vaccines, recombinant proteins and gene therapies.

Other Filtration

In 2018, we introduced our Konduit monitor to automate concentration and buffer exchange. We have broadened the application for Konduit monitor to include use with both HF TFF from Spectrum and our TangenX flat sheet TFF systems. We also self-manufacture HF filters that are used in our XCell ATF, KrosFlo TFF and KrosFlo TFDF systems.

Process Analytics Products

In May 2019, we consummated our acquisition of C Technologies, Inc. (“C Technologies”) and added a fourth franchise, Process Analytics, to our bioprocessing business. Our Process Analytics products complement and support our Filtration, Chromatography and Proteins franchises as they allow end-users to make at-line or in-line absorbance measurements allowing for the determination of protein concentration in filtration, chromatography formulation and fill-finish applications.

SoloVPE® Device

Our SoloVPE Slope Spectroscopy® system is the industry standard for offline and at-line absorbance measurements for protein concentration determination in process development, manufacturing and quality control settings.

FlowVPE® Device

Our FlowVPE Slope Spectroscopy system enhances the power of Slope Spectroscopy and provides in-line protein concentration measurement for filtration, chromatography and fill-finish applications. A key benefit of this in-line solution is the ability to monitor a manufacturing process in real time. We are developing a next-generation FlowVPE to incorporate GMP-compliant software for production-scale biologics manufacturing.

Use of VPE Slope Spectroscopy delivers multiple process benefits for our biopharmaceutical manufacturing customers, compared to traditional UV-Vis approaches. Key benefits include: the elimination of manual dilutions and sample transfers from process development/manufacturing to labs, rapid time to results (minutes versus hours), improved precision, built-in data quality for improved reporting and validation, and ease of use.

OEM Products (Proteins)

Our OEM products are represented by our Protein A affinity ligands, which are a critical component of Protein A chromatography resins used in downstream purification of mAb, and cell culture growth factor products, which are a key component of cell culture media used in upstream bioprocessing to increase cell density and improve product yield.

Proteins – Ligands

We are a leading provider of Protein A affinity ligands to life sciences companies. Protein A ligands are an essential "binding" component of Protein A affinity chromatography resins used in the purification of virtually all monoclonal antibody-based drugs on the market or in development. We manufacture multiple forms of Protein A ligands under long-term supply agreements with major life sciences companies including GE Healthcare ("GE"), MilliporeSigma and Purolite Life Sciences ("Purolite"), who in turn sell their Protein A chromatography resins to end users (mAb manufacturers). We have two manufacturing sites supporting overall global demand for our Protein A ligands: one in Lund, Sweden and another in Waltham, Massachusetts.

Protein A chromatography resins are considered the industry standard for purification of antibody-based therapeutics due to the ability of the Protein A ligand to very selectively bind to or "capture" antibodies from crude protein mixtures. Protein A resins are packed into the first chromatography column of typically three columns used in a mAb purification process. As a result of Protein A's high affinity for antibodies, the mAb product is highly purified and concentrated within this first capture step before moving to polishing steps.

In June 2018, we entered into an agreement with Navigo Proteins GmbH ("Navigo") for the exclusive co-development of multiple affinity ligands for which Repligen holds commercialization rights. We are manufacturing and have agreed to supply the first of these ligands, NGL-Impact® A, exclusively to Purolite, who will pair our high-performance ligand with Purolite's agarose jetting base bead technology used in their Jetted A50 Protein A resin product. We also signed a long-term supply agreement with Purolite for NGL-Impact A and potential additional affinity ligands that may advance from our Navigo collaboration. The Navigo and Purolite agreements are supportive of our strategy to secure and reinforce our Proteins franchise.

Proteins – Growth Factors

Most biopharmaceuticals are produced through an upstream mammalian cell culture process. In order to stimulate increased cell growth and maximize overall yield from a bioreactor, manufacturers often add growth factors, such as insulin, to their cell culture media. Our cell culture growth factor additives include LONG® R^3 IGF 1 ("LR3"), our insulin-like growth factor that has been shown to be up to 100 times more biologically potent than insulin (the industry standard), thereby increasing recombinant protein production in cell culture fermentation applications. LR3 is currently sold through a distribution partnership with MilliporeSigma.

Corporate Information

We are a Delaware corporation with global headquarters in Waltham, Massachusetts. We were incorporated in 1981 and became a publicly traded company in 1986. Our common stock is listed on The Nasdaq Global Market under the symbol "RGEN". We have over 761 employees and operate globally with offices and manufacturing sites located at multiple locations in the United States, Europe and Asia. Our principal executive offices are located at 41 Seyon Street, Waltham, Massachusetts 02453, our website is www.repligen.com and our telephone number is (781) 250-0111.

Our Market Opportunity

Bioprocessing Addressable Market

The global addressable market for bioprocessing products is estimated to be over $10 billion of which we estimate Repligen's addressable market to be approximately $2.8 billion at year end 2019. This market includes

products used to manufacture therapeutic antibodies, recombinant proteins and vaccines, as well as gene therapies – a rapidly emerging class of biologics.

Monoclonal Antibody Market

Antibody-based biologics alone accounted for over $130 billion of global biopharma revenue in 2018 and represented a majority of the top 10 best-selling drugs across the pharmaceutical industry. Industry sources project the mAb market to grow approximately 10% annually through 2022 driven by new approvals and expanded clinical uses for marketed antibodies as well as the emergence of biosimilar versions of originator mAbs.

In 2019, 12 mAbs/fusion proteins (nine originator and three biosimilars) were approved by the U.S. Food and Drug Administration ("FDA") to treat a diverse range of diseases. Indicative of the increased rate of approvals by the FDA since the first therapeutic antibody was brought to market in 1986, over 53% of the 112 U.S.-marketed mAbs were approved in the latest five-year period from 2015 through 2019, versus 18% in the prior five-year period from 2010 through 2014. In addition, R&D remains robust, with more than 550 mAbs at various stages of clinical development addressing a wide range of medical conditions.

In addition to investments in the discovery and development of novel biologic drugs, there has been substantial investment in follow-on products (biosimilars) by generic and specialty pharmaceutical as well as large biopharmaceutical companies. Development of follow-on products has accelerated as the first major mAbs have come off patent in the European Union and United States. Due to the high cost of biologic drugs, many countries in the developing and emerging markets have been aggressively investing in biomanufacturing capabilities to supply lower cost biosimilars for the local markets. For both originator and follow-on biologics manufacturing, Repligen products are well-positioned to enable greater manufacturing flexibility, production yields and lower costs through improved process efficiencies.

Cell and Gene Therapy Market

C&GT have emerged in the past few years to become a rapidly growing area of biological drug development, with over 1,000 clinical trials underway in 2019 according to industry sources. Eight cell therapies and two gene therapies have been approved by the FDA as of the end of 2019. Statements by the FDA are supported by industry reports that estimate annual revenue growth of 20% to 30% for the C&GT market over the next five years. This scientifically advanced therapeutic approach has unique manufacturing challenges that many of our products can help address. We believe we are well positioned to participate in gene therapy production, particularly in the manufacture of plasmids and viral vectors.

Direct Product Growth

Many of the products we manufacture are in the early stages of their adoption cycle, and, together with the expansion of our commercial organization and strategic acquisitions, have contributed to product revenue growth from $60.4 million in 2014, to $270.1 million in 2019. While all product lines have grown over this period, our diversification strategy has resulted in a significant increase in direct product sales as a percent of total product revenue, from 28% in 2014. By year end 2019, 76% of total bioprocessing revenue was attributable to direct product sales; 44% from our Filtration product line, 24% from our Chromatography product line, 6% from our Process Analytics product line and a small percentage from other sources including sales of hospital products that we obtained through our acquisition of Spectrum.

Customers use our products to produce initial quantities of drug for clinical studies, and then scale-up to larger volumes as the drug progresses to commercial production following regulatory approval. Detailed specifications for a drug's manufacturing process are included in applications that must be approved by regulators, such as the FDA, and the European Medicines Agency ("EMA"), throughout the clinical trial process and prior to final

commercial approval. As a result, products that become part of the manufacturing specifications of a late-stage clinical or commercial process can be very sensitive given the costs and uncertainties associated with displacing them.

The Biologics Manufacturing Process

Manufacturing biologic drugs requires three fundamental steps. First, upstream manufacturing involves the production of the biologic by living cells that are grown in a bioreactor (seed bioreactors, scaling up to a production bioreactor) under controlled conditions. These living cell "factories" are highly sensitive to the condition under which they grow, including the culture process and the composition of the cell culture media and the growth factors used to stimulate increased cell growth and protein production, or titre. Methods of production vary within the industry with the standard approach being fed-batch. With fed-batch culture, nutrients (cell culture media) are added to a production bioreactor only at the beginning of the culture or at defined feeding times to stimulate cell growth and production of the biologic drug of interest. The cells typically live and produce a biologic for 10-14 days prior to the culture health being impacted due to the accumulation of waste by-products. At the end of the culture time, the contents of the bioreactor then go through a harvest clarification step. The industry is increasingly adopting the perfusion (or continuous) method of cell culture. With perfusion cell culture, a cell retention device, like the XCell ATF system, is used to retain cells in the reactor. Fresh nutrients (cell culture media) can be circulated into the reactor continuously while clarified biological product and waste by-products are simultaneously and continuously removed from the reactor. Perfusion cultures can be run for up to 100 days, 30 days being typical, and the cell factories can be grown to a higher concentration and remain alive and producing biologic for significantly more time than with a fed-batch culture. The biologic of interest being removed continuously is already clarified, thus the harvest clarification step required for fed-batch cell culture, is not required for perfusion cell culture. The elimination of this step provides efficiency and cost savings in manufacturing. Some manufacturers are embracing a hybrid approach combining both fed-batch and perfusion methods. The second step is downstream processing where the biologic made during cell culture must be isolated and purified, typically through various filtration and chromatography steps. Each downstream purification process is unique but requires multiple chromatography and filtration steps to render the biologic of interest over 99% pure. Finally, the purified biologic drug is concentrated, formulated and then packaged into its final injectable form.

Biologics are generally high value therapies. Given the inherent complexities of the process and the final drug product, we have observed that manufacturers are seeking and investing in innovative technologies that address pain points in the production process in order to improve yields and improve throughput. Manufacturers are also seeking technologies that reduce costs as the biologic drug moves through clinical stages and into commercial processes by adopting single-use technologies as well as other products that yield increased flexibility and efficiency.

Our Strategy

We are focused on the development, production and commercialization of differentiated, technology-leading solutions or products that address specific pressure points in the biologics manufacturing process and deliver substantial value to our customers. Our products are designed to increase our customers' product yield, and we are committed to supporting our customers with strong customer service and applications expertise.

We intend to build on our recent history of developing market-leading solutions and delivering strong financial performance through the following strategies:

- *Continued innovation*. We plan to capitalize on our internal technological expertise to develop products that address unmet needs in upstream and downstream bioprocessing. We intend to invest further in our Proteins franchise while developing platform and derivative products to support our Filtration, Chromatography and Process Analytics franchises. We plan to strengthen our existing product lines

with complementary products and technologies that are designed to allow us to provide customers with a more efficient manufacturing process on one or more measures including flexibility, convenience, time savings, cost reduction and product yield.

- *Platforming our products.* A key strategy for accelerating market adoption of our products is delivery of enabling technologies that become the standard, or "platform," technology in markets where we compete. We focus our efforts on winning early-stage technology evaluations through direct interaction with the key biomanufacturing decision makers in process development labs. This strategy is designed to establish early adoption of our enabling technologies at key accounts, with opportunity for customers to scale up as the molecule advances to later stages of development and potential commercialization. We believe this approach can accelerate the implementation of our products as platform products, thereby strengthening our competitive advantage and contributing to long-term growth.
- *Targeted acquisitions*. We intend to continue to selectively pursue acquisitions of innovative technologies and products. We intend to leverage our balance sheet to acquire technologies and products that improve our overall financial performance by improving our competitiveness in filtration, chromatography or process analytics or by moving us into adjacent markets with common commercial call points.
- *Geographical expansion*. We intend to expand our global commercial presence by continuing to selectively build out our global sales, marketing, field applications and services infrastructure.
- *Operational efficiency*. We seek to expand operating margins through capacity utilization and process optimization strategies designed to increase our manufacturing yields. We plan to invest in systems to support our global operations, optimizing resources across our global footprint to maximize productivity.

Research and Development

Our research activities are focused on developing new high-value bioprocessing products across all of our franchises. We strive to continue to introduce truly differentiated products that address specific pain points in the biologics manufacturing process. Our commitment to innovation is core to the Repligen culture and our success as a company, with 6% to 8% of revenue focused on new product development and market expansion for existing products.

Sales and Marketing

Our sales and marketing strategy supports our objective of strengthening our position as a leading provider of products and services, addressing upstream, downstream and quality control needs of bioprocessing customers in the biopharmaceutical industry.

Direct-to-Customer Team

To support our sales goals for our direct-to-consumer products, we have invested in our commercial organization. Since 2014, we have significantly expanded our global commercial organization from less than 10, to a 134-person commercial team as of December 31, 2019. This includes 82 people in field positions (sales, field applications and field service), and 52 people in internal positions (marketing and customer service). We also have 22 employees in product management who support our commercial organization as well. Geographically, 81 members of our commercial team are located in North America, 23 in Europe and 30 in Asia-Pacific regions. Since 2018, we have substantially expanded our direct sales team in Asia, where we also work effectively with key distributors to serve our expanding customer base.

Our bioprocess account managers are supported in each region by bioprocess sales specialists with expertise in Filtration, Chromatography or Process Analytics, and by technically trained field applications specialists and

field service providers, who can work closely with customers on product demonstrations, implementation and support. We believe that this model helps drive further adoption at our key accounts and also open up new sales opportunities within each region.

OEM Agreements

For our Proteins franchise, we are committed to be a partner of choice for our customers with distributor and supply agreements in place with large life sciences companies such as GE, MilliporeSigma and Purolite. The GE Protein A supply agreement relating to our Lund, Sweden facility ran, pursuant to its terms, through 2019 and we expect GE to transfer a portion of their ligand manufacturing in-house in 2020. The GE Protein A supply agreement relating to our Waltham, Massachusetts facility runs, pursuant to its terms, through 2021. Our Protein A supply agreement with MilliporeSigma runs, pursuant to its terms, through 2023, and in 2018 we amended our Protein A supply agreement with Purolite that runs, pursuant to its terms, to August 2026 with an option for renewal through 2028. Our dual manufacturing capability provides strong business continuity and reduces overall supply risk for our OEM customers.

Significant Customers and Geographic Reporting

Customers for our bioprocessing products include major life science companies, contract manufacturing organizations, biopharmaceutical companies, diagnostics companies and laboratory researchers.

The following table represents the Company's total revenue by geographic area (based on the location of the customer):

	For the Years Ended December 31,		
	2019	2018	2017
Revenue by customers' geographic locations:			
North America	51%	48%	43%
Europe	37%	40%	46%
APAC	12%	12%	11%
Other	0%	0%	0%
Total revenue	100%	100%	100%

GE, one of our largest bioprocessing customers, accounted for 12%, 15% and 21% of total revenues in the years ended December 31, 2019, 2018 and 2017, respectively. Another customer, MilliporeSigma, accounted for 13%, 15% and 18% of total revenues in the years ended December 31, 2019, 2018 and 2017, respectively.

Employees

As of December 31, 2019, we had 761 employees, an increase of 213 since December 31, 2018. This includes 134 employees in our commercial organization (82 field and 52 internal), 77 in engineering and R&D, 274 in manufacturing, 98 in quality, 61 in supply chain roles, 22 in product management and 86 in administrative functions. Each of our employees has signed a confidentiality agreement. None of our U.S. employees are covered by collective bargaining agreements. We have one collective bargaining agreement with two unions that covers our 63 employees in Sweden, comprising approximately 8% of our total workforce. We renewed these collective bargaining agreements during 2017, and these collective bargaining agreements expire on March 31, 2020. We consider our employee relations to be satisfactory.

Intellectual Property

We are committed to protecting our intellectual property through a combination of patent, copyright, trade secret and trademark laws, as well as confidentiality agreements. As further described below, we own or have exclusive

rights to a number of U.S. patents and U.S. pending patent applications as well as corresponding foreign patents and patent applications.

Chromatography

Our issued patents cover certain unique methods and features of our OPUS PPC, including methods of making and loading these chromatography columns as well as the column structure. We continually seek to improve upon this technology and have multiple new patent filings including those covering gamma irradiation sterilization, packing methods, and methods of removing air using specialized tubing and valve systems.

Filtration

For our Filtration franchise, we are focusing on ATF, TFDF and TFF HF systems and filters. We continually seek to improve upon these technologies and have multiple new patent filings including those covering pumps and controllers, methods of harvesting, single-use products, and filters. Our patent for ATF and associated methods to use such a device in perfusion, acquired from Refine, expires in 2020, and we are proactively developing technology in an effort to mitigate any effects resulting from the expiration of this patent.

We currently have 52 patents granted (which expire over the next 20 years) and 106 patents pending in countries including Australia, Canada, China, France, Germany, India, Japan, Korea, Sweden, United Kingdom and the United States.

Our policy is to require each of our employees, consultants, business partners, potential collaborators and major customers to execute confidentiality agreements upon the commencement of an employment, consulting, business relationship, or product related audit with us. These agreements provide that all confidential information developed or made known to the other party during the course of the relationship with us is to be kept confidential and not disclosed to third parties except in specific circumstances. In the case of employees and consultants, the agreements generally provide that all inventions conceived by the individual in the course of rendering services to Repligen shall be our exclusive property and must be assigned to Repligen.

Process Analytics

Through our 2019 acquisition of C Technologies, we hold issued patents to Slope Spectroscopy instruments and related methods. These include patents to an “Interactive Variable Pathlength Device” that are set to expire in the United States beginning in April 2028. We also hold pending patents to methods of making Slope Spectroscopy standards and methods for using an interactive variable pathlength device.

Protein A

We currently hold a patent for “Nucleic Acids Encoding Recombinant Protein A,” which claims an isolated nucleic acid molecule that encodes a Protein A molecule with an amino acid sequence identical to that of the natural Protein A, which has long been commercialized for bioprocessing applications. This patent will remain in effect until June 2028. We also have two pending patents covering affinity ligands through our collaboration with Navigo.

Trademarks

We vigilantly protect our products and services’ branding by maintaining trademark registrations globally for the Repligen trademark and our key product brands. We have a comprehensive branding policy that includes trademark usage guidelines to ensure Repligen trademarks are used in a manner that provides the maximum protection.

We prioritize our "housemark" trademarks, (i.e., Repligen, Spectrum and TangenX), and ensure they are sufficiently protected and registered in key countries or regions globally, such as the United States, Canada, Europe and China. We also have product trademarks, including OPUS, XCell ATF, TFDF, KrosFlo, SIUS, ProConnex, Spectra/Por, NGL-Impact, SoloVPE and FlowVPE, that provide valuable company recognition and goodwill with our customers.

Our ability to compete effectively in the marketplace is dependent in part on our ability to protect our intellectual property rights, which includes protecting the trademarks we use in connection with our products and services. We rely on several registered and unregistered trademarks to protect our brand.

Licensing Agreements

We have entered into multiple licensing and collaboration relationships with third-party business partners in an effort to fully exploit our technology and advance our bioprocessing business strategy.

Competition

Our bioprocessing products compete on the basis of value proposition, performance, quality, cost effectiveness, and application suitability with numerous established technologies. Additional products using new technologies that may be competitive with our products may also be introduced. Many of the companies selling or developing competitive products, which in some cases include GE and MilliporeSigma, two of our largest customers, have greater financial and human resources, R&D, manufacturing and marketing experience than we do. They may undertake their own development of products that are substantially similar to or compete with our products and they may succeed in developing products that are more effective or less costly than any that we may develop. These competitors may also prove to be more successful in their production, marketing and commercialization activities. We cannot be certain that the research, development and commercialization efforts of our competitors will not render any of our existing or potential products obsolete.

Manufacturing

We manufacture seven commercial forms of Protein A, including "native" Protein A for life sciences companies, including GE, MilliporeSigma and Purolite, under long-term supply agreements which expire between 2020 and 2026. Native Protein A is manufactured in Lund, Sweden, while the recombinant forms are manufactured in both Waltham, Massachusetts and Lund, Sweden. We currently manufacture our growth factor products in Lund, Sweden. Our OPUS chromatography columns and ELISA test kit products are manufactured in Waltham, Massachusetts. Our OPUS columns are manufactured in Ravensburg, Germany, and our XCell ATF systems, XCell ATF single-use devices and SIUS TFF products are manufactured in our facility in Marlborough, Massachusetts. Our TFDF, KrosFlo, Spectra/Pro, Konduit and ProConnex lines of products are manufactured in Rancho Dominguez, California. Our operating room products are manufactured in Irving, Texas and our SoloVPE/VPM and FlowVPE/VPX Slope Spectroscopy variable pathlength products are manufactured in Bridgewater, New Jersey.

We utilize our own facilities in Waltham, Massachusetts and Lund, Sweden as well as third-party contract manufacturing organizations to carry out certain fermentation and recovery operations, while the purification, immobilization, packaging and quality control testing of our bioprocessing products are conducted at our facilities. Our facilities located in Waltham, Massachusetts; Lund, Sweden; Ravensburg, Germany; Bridgewater, New Jersey; and Rancho Dominguez, California are ISO 9001:2015 certified and maintain formal quality systems to maintain process control, traceability, and product conformance. Additionally, our facility in Irving, Texas is ISO 13485:2012 certified. We practice continuous improvement initiatives based on routine internal audits as well as external feedback and audits performed by our partners and customers. In addition, we maintain a business continuity management system which focuses on key areas such as contingency planning, security stocks and off-site storage of raw materials and finished goods to ensure continuous supply of our products.

Available Information

We maintain a website with the address www.repligen.com. We are not including the information contained on our website as a part of, or incorporating it by reference into, this Form 10-K. We make available free of charge through our website our Form 10-Ks, Quarterly Reports on Form 10-Q and Current Reports on Form 8-K, and amendments to these reports, as soon as reasonably practicable after we electronically file such materials with, or furnish such materials to, the Securities and Exchange Commission ("SEC"). Our Code of Business Conduct and Ethics is also available free of charge through our website.

Our filings with the SEC may be accessed through the SEC's Electronic Data Gathering, Analysis and Retrieval ("EDGAR") system at www.sec.gov.

ITEM 1A. RISK FACTORS

Investors should carefully consider the risk factors described below before making an investment decision.

If any of the events described in the following risk factors occur, our business, financial condition or results of operations could be materially harmed. In that case the trading price of our common stock could decline, and investors may lose all or part of their investment. Additional risks and uncertainties that we are unaware of or that we currently deem immaterial may also become important factors that affect Repligen.

This Annual Report on Form 10-K ("Form 10-K") contains forward looking statements that involve risks and uncertainties. Our actual results could differ materially from those anticipated in these forward-looking statements as a result of certain factors, including the risks faced by us described below and elsewhere in this Form 10-K.

We face competition from numerous competitors, most of whom have far greater resources than we have, which may make it more difficult for us to achieve significant market penetration.

The bioprocessing market is intensely competitive, subject to rapid change and significantly affected by new product introductions and other market activities of industry participants.

Many of our competitors are large, well-capitalized companies with significantly more market share and resources than we have. As a consequence, they are able to spend more aggressively on product development, marketing, sales and other product initiatives than we can. Many of these competitors have:

- significantly greater name recognition;
- larger and more established distribution networks;
- additional lines of products and the ability to bundle products to offer higher discounts or other incentives to gain a competitive advantage;
- greater experience in conducting research and development, manufacturing, clinical trials, marketing, obtaining regulatory approval and entering into collaborations or other strategic partnership arrangements; and
- greater financial and human resources for product development, sales and marketing and patent litigation.

Our current and future competitors, including certain of our customers, may at any time develop additional products that compete with our products. If any company develops products that compete with or are superior to our products, our revenue may decline. In addition, some of our competitors may compete by lowering the price of their products. If prices were to fall, we may not be able to improve our gross margins or sales growth sufficiently to maintain and grow our profitability.

Despite our increasingly diversified client base, we have historically depended on a limited number of customers for a high percentage of our revenues.

The loss of, or a significant reduction in orders from, any of our large customers, including following any termination or failure to renew a long-term supply contract, would significantly reduce our revenues and harm our results of operations. If a large customer purchases fewer of our products, defers orders or fails to place additional orders with us for any reason, including for business continuity purposes, our revenue could decline, and our operating results may not meet market expectations. Under long-term supply agreements with GE Healthcare ("GE"), we have supplied Protein A ligands to GE from our manufacturing facilities in Lund, Sweden and Waltham, Massachusetts (the "Lund Agreement" and "Waltham Agreement," respectively). The Lund Agreement terminated pursuant to its terms in December 2019 and was not renewed. The Waltham Agreement runs, pursuant to its terms, through December 2021.

In addition, if our customers order our products, but fail to pay on time or at all, our liquidity and operating results could be materially and adversely affected. Furthermore, if any of our current or future products compete with those of any of our largest customers, these customers may place fewer orders with us or cease placing orders with us, which would negatively affect our revenues and operating results.

If we are unable to expand our product portfolio, our ability to generate revenue could be adversely affected.

We are increasingly seeking to develop and commercialize our portfolio of products. Our future financial performance will depend, in part, on our ability to successfully develop and acquire additional bioprocessing products. There is no guarantee that we will be able to successfully acquire or develop additional bioprocessing products, and the Company's financial performance will likely suffer if we are unable to do so.

If intangible assets and goodwill that we recorded in connection with our acquisitions become impaired, we may have to take significant charges against earnings.

In connection with the accounting for our completed acquisitions, we recorded a significant amount of intangible assets, including developed technology and customer relationships relating to the acquired product lines, and goodwill. Under U.S. GAAP, we must assess, at least annually and potentially more frequently, whether the value of intangible assets and goodwill has been impaired. Intangible assets and goodwill will be assessed for impairment in the event of an impairment indicator. Any reduction or impairment of the value of intangible assets and goodwill will result in a charge against earnings, which could materially adversely affect our results of operations and shareholders' equity in future periods.

Our exposure to political, economic and other risks that arise from operating a multinational business has and may continue to increase.

We operate on a global basis with offices or activities in Japan, South Korea, China, India, Europe and North America. Our operations and sales outside of the United States have increased as a result of our strategic acquisitions and the continued expansion of our commercial organization. Risks related to these increased foreign operations include:

- fluctuations in foreign currency exchange rates, which may affect the costs incurred in international operations and could harm our results of operations and financial condition;
- changes in general economic and political conditions in countries where we operate, particularly as a result of ongoing economic instability within foreign jurisdictions;
- the occurrence of a trade war, or other governmental action related to tariffs or trade agreements;
- being subject to complex and restrictive employment and labor laws and regulations, as well as union and works council restrictions;

- changes in tax laws or rulings in the United States or other foreign jurisdictions that may have an adverse impact on our effective tax rate;
- being subject to burdensome foreign laws and regulations, including regulations that may place an increased tax burden on our operations;
- being subject to longer payment cycles from customers and experiencing greater difficulties in timely accounts receivable collections; and
- required compliance with a variety of foreign laws and regulations, such as data privacy requirements, real estate and property laws, anti-competition regulations, import and trade restrictions, export requirements, U.S. laws such as the Foreign Corrupt Practices Act of 1977 and the U.S. Department of Commerce's Export Administration Regulations, and other U.S. federal laws and regulations established by the office of Foreign Asset Control, local laws such as the U.K. Bribery Act of 2010 or other local laws that prohibit corrupt payments to governmental officials or certain payments or remunerations to customers.

Our business success depends in part on our ability to anticipate and effectively manage these and other related factors. We cannot assure you that these and other related factors will not materially adversely affect our international operations or business as a whole.

In addition, a deterioration in diplomatic relations between the United States and any country where we conduct business could adversely affect our future operations and lead to a decline in profitability. In 2018 and 2019, the United States imposed tariffs on goods imported from China and certain other countries, which has resulted in retaliatory tariffs by China and other countries. Additional tariffs or further retaliatory trade measures taken by China or other countries in response, could affect the demand for our products and services, impact the competitive position of our products, prevent us from being able to sell products in certain countries or otherwise adversely impact our results of operations.

We are subject to export and import control laws and regulations that could impair our ability to compete in international markets or subject us to liability if we violate such laws and regulations.

We are subject to U.S. export controls and sanctions regulations that restrict the shipment or provision of certain products and services to certain countries, governments, and persons. While we take precautions to prevent our products and services from being exported in violation of these laws, we cannot guarantee that the precautions we take will prevent violations of export control and sanctions laws. We believe that, in the past, we and our subsidiaries may have exported certain products without a required export license in apparent violation of U.S. export control laws. As a result, we have submitted to the U.S. Department of Commerce's Bureau of Industry and Security various notices of voluntary self-disclosure concerning potential violations. If we are found to be in violation of U.S. sanctions or export control laws, it could result in substantial fines and penalties for us and for the individuals working for us. We may also be adversely affected through other penalties, reputational harm, loss of access to certain markets, or otherwise.

Complying with export control and sanctions regulations may be time consuming and may result in the delay or loss of sales opportunities or impose other costs. Any change in export or import regulations, economic sanctions or related legislation, or change in the countries, governments, persons or technologies targeted by such regulations, could result in our decreased ability to export or sell certain products to existing or potential customers in affected jurisdictions.

We may be unable to efficiently manage our growth as a larger and more geographically diverse organization.

Our strategic acquisitions, the continued expansion of our commercial sales operations, and our organic growth have increased the scope and complexity of our business. As a result, we will face challenges inherent in

efficiently managing a more complex business with an increased number of employees over large geographic distances, including the need to implement appropriate systems, policies, benefits and compliance programs. Our inability to manage successfully the geographically more diverse (including from a cultural perspective) and substantially larger combined organization could materially adversely affect our operating results and, as a result, the market price of our common stock.

Our business is subject to a number of environmental risks.

Our manufacturing business involves the controlled use of hazardous materials and chemicals and is therefore subject to numerous environmental and safety laws and regulations and to periodic inspections for possible violations of these laws and regulations. In addition to these hazardous materials and chemicals, our facility in Sweden also uses Staphylococcus aureus and toxins produced by Staphylococcus aureus in some of its manufacturing processes. Staphylococcus aureus and the toxins it produces, particularly enterotoxins, can cause severe illness in humans. The costs of compliance with environmental and safety laws and regulations are significant. Any violations, even if inadvertent or accidental, of current or future environmental and safety laws or regulations and the cost of compliance with any resulting order or fine could adversely affect our operations.

Our acquisitions expose us to risks that could adversely affect our business, and we may not achieve the anticipated benefits of acquisitions of businesses or technologies.

As a part of our growth strategy, we may make selected acquisitions of complementary products and/or businesses. Any acquisition involves numerous risks and operational, financial, and managerial challenges, including the following, any of which could adversely affect our business, financial condition, or results of operations:

- difficulties in integrating new operations, technologies, products, and personnel;
- problems maintaining uniform procedures, controls and policies with respect to our financial accounting systems;
- lack of synergies or the inability to realize expected synergies and cost-savings;
- difficulties in managing geographically dispersed operations, including risks associated with entering foreign markets in which we have no or limited prior experience;
- underperformance of any acquired technology, product, or business relative to our expectations and the price we paid;
- negative near-term impacts on financial results after an acquisition, including acquisition-related earnings charges;
- the potential loss of key employees, customers, and strategic partners of acquired companies;
- claims by terminated employees and shareholders of acquired companies or other third parties related to the transaction;
- the assumption or incurrence of additional debt obligations or expenses, or use of substantial portions of our cash;
- the issuance of equity securities to finance or as consideration for any acquisitions that dilute the ownership of our stockholders;
- the issuance of equity securities to finance or as consideration for any acquisitions may not be an option if the price of our common stock is low or volatile which could preclude us from completing any such acquisitions;
- any collaboration, strategic alliance and licensing arrangement may require us to relinquish valuable rights to our technologies or product candidates, or grant licenses on terms that are not favorable to us;

- diversion of management's attention and company resources from existing operations of the business;
- inconsistencies in standards, controls, procedures, and policies;
- the impairment of intangible assets as a result of technological advancements, or worse-than-expected performance of acquired companies;
- assumption of, or exposure to, historical liabilities of the acquired business, including unknown contingent or similar liabilities that are difficult to identify or accurately quantify; and
- risks associated with acquiring intellectual property, including potential disputes regarding acquired companies' intellectual property.

In addition, the successful integration of acquired businesses requires significant efforts and expense across all operational areas, including sales and marketing, research and development, manufacturing, finance, legal, and information technologies. There can be no assurance that any of the acquisitions we may make will be successful or will be, or will remain, profitable. Our failure to successfully address the foregoing risks may prevent us from achieving the anticipated benefits from any acquisition in a reasonable time frame, or at all.

Servicing our debt will require a significant amount of cash, and we may not have sufficient cash flow from our business to make payments on our debt.

In 2019, we incurred significant indebtedness in the amount of $287.5 million in aggregate principal with additional accrued interest under our 0.375% Convertible Senior Notes due 2024 (the "2019 Notes"). Our ability to make scheduled payments of the principal of, to pay interest on, or to refinance our indebtedness, including the 2019 Notes, depends on our future performance, which is subject to economic, financial, competitive and other factors that may be beyond our control. Our business may not generate cash flow from operations in the future sufficient to service our debt and make necessary capital expenditures. If we are unable to generate such cash flow, we may be required to adopt one or more alternatives, such as selling assets, restructuring debt or obtaining additional equity capital on terms that may be onerous or highly dilutive. Our ability to refinance our indebtedness will depend on the capital markets and our financial condition at such time. In addition, in the event of a fundamental change or a default under the 2019 Notes, the holders and/or the trustee under the indentures governing the 2019 Notes may accelerate the payment obligations or trigger the holders' repurchase rights under the 2019 Notes. We may not be able to engage in any of these activities or engage in these activities on desirable terms, which could result in a default on our debt obligations, including the 2019 Notes.

If a make-whole fundamental change, such as an acquisition of our company, occurs prior to the maturity of the 2019 Notes, under certain circumstances, the conversion rate for the 2019 Notes will increase such that additional shares of our common stock will be issued upon conversion of the 2019 Notes in connection with such make-whole fundamental change. The increase in the conversion rate will be determined based on the date on which the make-whole fundamental change occurs or becomes effective and the price paid (or deemed paid) per share of our common stock in such transaction. Upon conversion of the 2019 Notes, unless we elect to deliver solely shares of our common stock to settle such conversion (other than paying cash in lieu of delivering any fractional share), we will be required to make cash payments in respect of the 2019 Notes being converted. We may not have enough available cash or be able to obtain financing at the time we are required to make repurchases of 2019 Notes surrendered therefor or notes being converted. Our failure to repurchase 2019 Notes at a time when the repurchase is required by the indenture or to pay any cash payable on future conversions of the 2019 Notes as required by the indenture would constitute a default under the indenture. If the repayment of the related indebtedness were to be accelerated after any applicable notice or grace periods, we may not have sufficient funds to repay the indebtedness and repurchase the 2019 Notes or make cash payments upon conversions thereof.

In addition, our significant indebtedness, combined with our other financial obligations and contractual commitments, could have other important consequences. For example, it could:

- make us more vulnerable to adverse changes in general U.S. and worldwide economic, industry and competitive conditions and adverse changes in government regulation;

- limit our flexibility in planning for, or reacting to, changes in our business and our industry;
- place us at a disadvantage compared to our competitors who have less debt; and
- limit our ability to borrow additional amounts for working capital and other general corporate purposes, including to fund possible acquisitions of, or investments in, complementary businesses, products, services and technologies.

Any of these factors could materially and adversely affect our business, financial condition and results of operations. In addition, if we incur additional indebtedness, the risks related to our business and our ability to service or repay our indebtedness would increase.

Future strategic transactions or acquisitions may require us to seek additional financing, which we may not be able to secure on favorable terms, if at all.

We plan to continue a strategy of growth and development for our bioprocessing business, and we actively evaluate various strategic transactions on an ongoing basis, including licensing or acquiring complementary products, technologies or businesses that would complement our existing portfolio of development programs. In order to complete such strategic transactions, we may need to seek additional financing to fund these investments and acquisitions. Should we need to do so, we may not be able to secure such financing, or obtain such financing on favorable terms because of the volatile nature of the biotechnology marketplace. In addition, future acquisitions may require the issuance or sale of additional equity or debt securities, which may result in additional dilution to our stockholders.

We rely on a limited number of suppliers or, for certain of our products, one supplier, and we may not be able to find replacements or immediately transition to alternative suppliers, which could have a material adverse effect on our financial condition, results of operations and reputation.

There are only a limited number of suppliers of materials for certain of our products. An interruption in operations of the business related to these products could occur if we encounter delays or difficulties in securing the required materials, or if we cannot then obtain an acceptable substitute. Any such interruption could significantly affect the business related to these products and our financial condition, results of operations and reputation.

For example, we believe that only a small number of suppliers are currently qualified to supply materials for the XCell Alternating Tangential Filtration ("ATF")™ systems. The use of materials furnished by these replacement suppliers would require us to alter our operations related to the XCell ATF systems. Transitioning to a new supplier for our products would be time consuming and expensive, may result in interruptions in our operations, could affect the performance specifications of our product lines or could require that we revalidate the materials. There can be no assurance that we will be able to secure alternative materials and bring such materials online and revalidate them without experiencing interruptions in our workflow. If we should encounter delays or difficulties in securing, reconfiguring or revalidating the materials required for our products, our business related to these products and our financial condition, results of operations and reputation could be adversely affected.

As we evolve from a company dependent on others to commercialize our products to a company selling directly to end users, we may encounter difficulties in expanding our product portfolio and our commercial marketing capabilities.

Prior to 2016, we generated most of our revenues through sales of bioprocessing products to a limited number of life sciences companies, such as GE, MilliporeSigma and other individual distributors. However, due in part to our recent strategic acquisitions, an increasing amount of our revenue is attributable to our commercialization of bioprocessing products that we sell directly to end-users, including biopharmaceutical companies and contract manufacturing organizations. This has required and will continue to require us to invest additional resources in

our sales and marketing capabilities. We may not be able to attract and retain additional sales and marketing professionals, and the cost of building the sales and marketing function may not generate our anticipated revenue growth. In addition, our sales and marketing efforts may be unsuccessful. Our failure to manage these risks may have a negative impact on our financial condition, or results of operations and may cause our stock price to decline.

If we are unable to obtain or maintain our intellectual property, we may not be able to succeed commercially.

We endeavor to obtain and maintain trade secrets and, to a lesser extent with respect to the products that currently account for a majority of our revenue, patent protection when available in order to protect our products and processes from unauthorized use and to produce a financial return consistent with the significant time and expense required to bring our products to market. Our success will depend, in part, on our ability to:

- preserve our trade secrets and know-how;
- operate without infringing the proprietary rights of third parties;
- obtain and maintain patent protection for our products and manufacturing processes; and
- secure any necessary licenses from others on acceptable terms.

We consider trade secrets, know-how and other forms of market protection to be among the most important elements of our proprietary position, in particular, as it relates to the products that currently account for a majority of our revenue. We also own or have exclusive rights to a number of U.S. patents and U.S. pending patent applications as well as corresponding foreign patents and patent applications. We continue to actively and selectively pursue patent protection and seek to expand our patent estate, particularly for our products currently in development, and we cannot be sure that any patent applications that we will file in the future or that any currently pending applications will issue on a timely basis, if ever. We cannot be certain that we were the first to make the inventions covered by each of our pending patent applications or that we were the first to file patent applications for such inventions. Even if patents are issued, the degree of protection afforded by such patents will depend upon the:

- scope of the patent claims;
- validity and enforceability of the claims obtained in such patents; and
- our willingness and financial ability to enforce and/or defend them.

The patent position of life sciences companies is often highly uncertain and usually involves complex legal and scientific questions. Patents which may be granted to us in certain foreign countries may be subject to opposition proceedings brought by third parties or result in suits by us, which may be costly and result in adverse consequences for us.

In some cases, litigation or other proceedings may be necessary to assert claims of infringement, to enforce patents issued to us or our licensors, to protect trade secrets, know-how or other intellectual property rights we own or to determine the scope and validity of the proprietary rights of third parties. Such litigation could result in substantial cost to us and diversion of our resources. An adverse outcome in any such litigation or proceeding could have a material adverse effect on our business, financial condition and results of operations. If our competitors prepare and file patent applications in the United States that claim technology also claimed by us, we may be required to participate in interference proceedings declared by the U.S. Patent and Trademark Office to determine priority of invention, which would result in substantial costs to us.

While one of our U.S. patents covering recombinant Protein A had its term adjusted to expire in 2028, our other U.S. patents covering recombinant Protein A have expired, and as a result, we may face increased competition, which could harm our results of operations, financial condition, cash flow and future prospects.

Other companies could begin manufacturing and selling native or some of the commercial forms of recombinant Protein A in the United States and may directly compete with us on certain Protein A products. This may induce us to sell Protein A at lower prices and may erode our market share, which could adversely affect our results of operations, financial condition, cash flow and future prospects.

Our freedom to develop our products may be challenged by others, and we may have to engage in litigation to determine the scope and validity of competitors' patents and proprietary rights, which, if we do not prevail, could harm our business, results of operations, financial condition, cash flow and future prospects.

There has been substantial litigation and other proceedings regarding the complex patent and other intellectual property rights in the life sciences industry. We have been a party to, and in the future may become a party to, patent litigation or other proceedings regarding intellectual property rights.

Other types of situations in which we may become involved in patent litigation or other intellectual property proceedings include:

We may initiate litigation or other proceedings against third parties to seek to invalidate the patents held by such third parties or to obtain a judgment that our products or services do not infringe such third parties' patents.

- We may initiate litigation or other proceedings against third parties to seek to enforce our patents against infringement.
- If our competitors file patent applications that claim technology also claimed by us, we may participate in interference or opposition proceedings to determine the priority of invention.
- If third-parties initiate litigation claiming that our processes or products infringe their patent or other intellectual property rights, we will need to defend against such claims.

The cost to us of any patent litigation or other proceeding, even if resolved in our favor, could be substantial. Some of our competitors may be able to sustain the cost of such litigation or proceedings more effectively than we can because of their substantially greater financial resources. If a patent litigation or other intellectual property proceeding is resolved in a way that is unfavorable to us, we or our collaborative or strategic partners may be enjoined from manufacturing or selling our products and services without a license from the other party and be held liable for significant damages. The failure to obtain any required license on commercially acceptable terms or at all may harm our business, results of operations, financial condition, cash flow and future prospects.

Uncertainties resulting from the initiation and continuation of patent litigation or other proceedings could have a material adverse effect on our ability to compete in the marketplace. Patent litigation and other proceedings may also absorb significant management time, attention and resources.

We may become involved in litigation or other proceedings with collaborative partners, which may be time consuming, costly and could result in delays in our development and commercialization efforts.

In connection with the Company's decision to focus its efforts on the growth of its core bioprocessing business, we sought development and commercialization partnerships for our remaining portfolio of clinical stage assets. Any disputes with such partners that lead to litigation or similar proceedings may result in us incurring legal expenses, as well as facing potential legal liability. Such disputes, litigation or other proceedings are also time consuming and may cause delays in our development and commercialization efforts. If we fail to resolve these disputes quickly and with terms that are no less favorable to us than the current terms of the arrangements, our business, results of operations, financial condition, cash flow and future prospects may be harmed.

If we are unable to continue to hire and retain skilled personnel, then we will have trouble developing and marketing our products.

Our success depends largely upon the continued service of our management and scientific staff and our ability to attract, retain and motivate highly skilled technical, scientific, management and marketing personnel. We also face significant competition in the hiring and retention of such personnel from other companies, research and academic institutions, government and other organizations who have superior funding and resources. The loss of key personnel or our inability to hire and retain skilled personnel could materially adversely affect our product development efforts and our business.

The market may not be receptive to our new bioprocessing products upon their introduction.

We expect a portion of our future revenue growth to come from introducing new bioprocessing products, including line extensions and new features for our OPUS® disposable chromatography columns, our XCell ATF system, our SIUS™ tangential flow filtration ("TFF") cassettes, our Spectrum® hollow fiber modules TFF line of cassettes and our growth factors. The commercial success of all of our products will depend upon their acceptance by the life science and biopharmaceutical industries. Many of the bioprocessing products that we are developing are based upon new technologies or approaches. As a result, there can be no assurance that these new products, even if successfully developed and introduced, will be accepted by customers. If customers do not adopt our new products and technologies, our results of operations may suffer and, as a result, the market price of our common stock may decline.

Our products are subject to quality control requirements.

Whether a product is produced by us or purchased from outside suppliers, it is subjected to quality control procedures, including the verification of porosity and with certain products, the complete validation for good manufacturing practices, U.S. Food and Drug Administration, CE and ISO 2001 compliance, prior to final packaging. Quality control is performed by a staff of technicians utilizing calibrated equipment. In the event we, or our manufacturers, produce products that fail to comply with required quality standards, it may incur delays in fulfilling orders, write-downs, damage to our reputation and damages resulting from product liability claims.

If our products do not perform as expected or the reliability of the technology on which our products are based is questioned, we could experience lost revenue, delayed or reduced market acceptance of our products, increased costs and damage to our reputation.

Our success depends on the market's confidence that we can provide reliable, high-quality bioprocessing products. We believe that customers in our target markets are likely to be particularly sensitive to product defects and errors. Our reputation and the public image of our products and technologies may be impaired if our products fail to perform as expected. Although our products are tested prior to shipment, defects or errors could nonetheless occur in our products. Furthermore, the Protein A that we manufacture is subsequently incorporated into products that are sold by other life sciences companies and we have no control over the manufacture and production of those products. In the future, if our products experience, or are perceived to experience, a material defect or error, this could result in loss or delay of revenues, delayed market acceptance, damaged reputation, diversion of development resources, legal claims, increased insurance costs or increased service and warranty costs, any of which could harm our business. Such defects or errors could also narrow the scope of the use of our products, which could hinder our success in the market. Even after any underlying concerns or problems are resolved, any lingering concerns in our target market regarding our technology or any manufacturing defects or performance errors in our products could continue to result in lost revenue, delayed market acceptance, damaged reputation, increased service and warranty costs and claims against us.

If we are unable to manufacture our products in sufficient quantities and in a timely manner, our operating results will be harmed, our ability to generate revenue could be diminished and our gross margin may be negatively impacted.

Our revenues and other operating results will depend in large part on our ability to manufacture and assemble our products in sufficient quantities and in a timely manner. Any interruptions we experience in the manufacturing or shipping of our products could delay our ability to recognize revenues in a particular quarter. Manufacturing problems can and do arise, and as demand for our products increases, any such problems could have an increasingly significant impact on our operating results. While we have not generally experienced problems with, or delays in, our production capabilities that resulted in delays in our ability to ship finished products, there can be no assurance that we will not encounter such problems in the future. We may not be able to quickly ship products and recognize anticipated revenues for a given period if we experience significant delays in the manufacturing process. In addition, we must maintain sufficient production capacity in order to meet anticipated customer demand, which carries fixed costs that we may not be able to offset if orders slow, which would adversely affect our operating margins. If we are unable to manufacture our products consistently, in sufficient quantities, and on a timely basis, our bioprocessing revenue, gross margins and our other operating results will be materially and adversely affected.

Our operating results may fluctuate significantly, our customers' future purchases are difficult to predict and any failure to meet financial expectations may result in a decline in our stock price.

Our quarterly operating results may fluctuate in the future as a result of many factors such as the impact of seasonal spending patterns, changes in overall spending levels in the life sciences industry, the inability of some of our customers to consummate anticipated purchases of our products due to changes in end-user demand, and other unpredictable factors that may affect ordering patterns. Because our revenue and operating results are difficult to predict, we believe that our past results of operations are not necessarily a good indicator of our future performance. Additionally, if revenue declines in a quarter, whether due to a delay in recognizing expected revenue, adverse economic conditions or otherwise, our results of operations will be harmed because many of our expenses are relatively fixed. In particular, a large portion of our manufacturing costs, our research and development, sales and marketing and general and administrative expenses are not significantly affected by variations in revenue. Further, our gross margins are dependent on product mix. A shift in sales mix away from our higher margin products to lower margin products will adversely affect our gross margins. If our quarterly operating results fail to meet investor expectations, the price of our common stock may decline.

Securities or industry analysts may not publish favorable research or reports about our business or may publish no information, which could cause our stock price or trading volume to decline.

The trading market for our common stock is influenced by the research and reports that industry or securities analysts publish about us and our business. We do not have any control over these analysts and we cannot provide any assurance that analysts will cover us or provide favorable coverage. If any of the analysts who cover us issue an adverse opinion regarding our stock price, our business or stock price would likely decline. If one or more of these analysts cease coverage of our company or fail to regularly publish reports covering us, we could lose visibility in the market, which in turn could cause our stock price or trading volume to decline.

Health care reform measures could adversely affect our business.

The efforts of governmental and third-party payors to contain or reduce the costs of health care may adversely affect the business and financial condition of pharmaceutical and biotechnology companies, including ours. Specifically, in both the United States and some foreign jurisdictions, there have been a number of legislative and regulatory proposals to change the health care system in ways that could affect our ability to sell our products profitably. For example, in March 2010, the Patient Protection and Affordable Care Act, as amended by the Health Care and Education Reconciliation Act of 2010 (together, the "Affordable Care Act"), was passed, which

substantially changes the way health care is financed by both governmental and private insurers and significantly impacts the U.S. life sciences industry. The Affordable Care Act and other federal and state proposals and health care reforms could limit the prices that can be charged for the products we develop and may limit our commercial opportunity. In the United States, the Medicare Prescription Drug, Improvement, and Modernization Act of 2003, also called the Medicare Modernization Act (the "MMA") changed the way Medicare covers and pays for pharmaceutical products. These cost reduction initiatives and other provisions of this legislation could decrease the coverage and price that we receive for any approved products and could seriously harm our business. While the MMA applies only to drug benefits for Medicare beneficiaries, private payors often follow Medicare coverage policy and payment limitations in setting their own reimbursement rates, and any reduction in reimbursement that results from the MMA may result in a similar reduction in payments from private payors. Efforts by the government and other third-party payors to contain or reduce the costs of health care through various means may limit our commercial opportunities and result in a decrease in the price of our common stock or limit our ability to raise capital.

Recent federal government efforts have been aimed at amending or repealing all or portions of existing health care reform legislation, including the Affordable Care Act. Changes in existing health care reform measures may result in uncertainty with respect to legislation, regulation and government policy that could significantly impact our business and the life sciences industry.

The enactment of legislation implementing changes in taxation of international business activities, the adoption of other corporate tax reform policies, or changes in tax legislation or policies, or interpretations thereof, could materially impact our financial position and results of operations.

Corporate tax reform, base-erosion efforts and tax transparency continue to be high priorities in many tax jurisdictions where we have business operations. As a result, policies regarding corporate income and other taxes in numerous jurisdictions are under heightened scrutiny and tax reform legislation is being proposed or enacted in a number of jurisdictions. For example, the Tax Cuts and Jobs Act (the "2017 Tax Reform Act"), adopting broad U.S. corporate income tax reform will, among other things, reduce the U.S. corporate income tax rate, but will impose base-erosion prevention measures on earnings of non-U.S. subsidiaries of U.S. entities as well as the transition tax on mandatory deemed repatriation of accumulated non-U.S. earnings of U.S. controlled foreign corporations. There is no assurance that our actual income tax liability will not be materially different than what is reflected in our income tax provisions and accruals.

In addition, many countries are beginning to implement legislation and other guidance to align their international tax rules with the Organisation for Economic Co-operation and Development's Base Erosion and Profit Shifting recommendations and action plan that aim to standardize and modernize global corporate tax policy, including changes to cross-border tax, transfer pricing documentation rules, and nexus-based tax incentive practices. Because of the heightened scrutiny of corporate taxation policies, prior decisions by tax authorities regarding treatments and positions of corporate income taxes could be subject to enforcement activities, and legislative investigation and inquiry, which could also result in changes in tax policies or prior tax rulings. Any such changes in policies or rulings may also result in the taxes we previously paid being subject to change.

Due to the large scale of our international business activities, any substantial changes in international corporate tax policies, enforcement activities or legislative initiatives may materially adversely affect our business, the amount of taxes we are required to pay and our financial condition and results of operations generally.

We compete with life science, pharmaceutical and biotechnology companies who are capable of developing new approaches that could make our products and technology obsolete.

The market for therapeutic and commercial products is intensely competitive, rapidly evolving and subject to rapid technological change. We compete with several medium and small companies in each of our product categories as well as several large companies, including GE, Danaher Corporation (Pall), Thermo Fisher

Scientific Inc., MilliporeSigma and Sartorius. These competitors, as well as other life science, pharmaceutical and biotechnology companies may have greater financial, manufacturing, marketing, and research and development resources than we have, as well as stronger name recognition, longer operating histories and benefits derived from greater economies of scale. These factors, among others, may enable our competitors to market their products at lower prices or on terms more advantageous to customers than what we can offer. Competition may result in price reductions, reduced gross margins and loss of market share, any of which could have a material adverse effect on our business, financial condition and results of operations. Additionally, new approaches by these competitors may make our products and technologies obsolete or noncompetitive.

We may become subject to litigation, which could result in substantial costs and divert management's attention and resources from our business.

From time to time, we may become involved in litigation or other legal proceedings relating to claims arising from the ordinary course of business. Litigation is subject to inherent risks and uncertainties that may cause actual results to differ materially from our expectations. If we receive an adverse judgment in any litigation, we could be required to pay substantial damages. With or without merit, litigation can be complex, can extend for a protracted period of time, can be very expensive and the expense can be unpredictable. Litigation initiated by us could also result in counter-claims against us, which could increase the costs associated with the litigation and result in our payment of damages or other judgments against us. In addition, litigation, and any related publicity, may divert the efforts and attention of some of our management and key personnel, which could adversely affect our business.

We may be exposed to liabilities under the Foreign Corrupt Practices Act, and any determination that we violated the Foreign Corrupt Practices Act could have a material adverse effect on our business.

We are subject to the Foreign Corrupt Practice Act of 1977 (the "FCPA") and other laws that prohibit improper payments or offers of payments to foreign governments and their officials and political parties by U.S. persons and issuers as defined by the statute for the purpose of obtaining or retaining business. We have operations and agreements with third parties and make sales in jurisdictions outside of the United States, which may experience corruption. Our activities in jurisdictions outside of the United States create the risk of unauthorized payments or offers of payments by one of our employees, consultants, sales agents or distributors, because these parties are not always subject to our control. These risks have increased following our recent acquisitions of overseas operations and facilities. It is our policy to implement safeguards to discourage these practices by our employees. However, our existing safeguards and any future improvements may prove to be less than effective, and the employees, consultants, sales agents or distributors of our Company may engage in conduct for which we might be held responsible. Violations of the FCPA may result in severe criminal or civil sanctions, and we may be subject to other liabilities, which could negatively affect our business, operating results and financial condition. In addition, the government may seek to hold us liable for successor liability FCPA violations committed by any companies in which we invest or that we acquire.

Our stock price could be volatile, which could cause shareholders to lose part or all of their investment.

The market price of our common stock, like that of the common stock of many other companies with similar market capitalizations, is highly volatile. In addition, the stock market has experienced extreme price and volume fluctuations. This volatility has significantly affected the market prices of securities of many life sciences, biotechnology and pharmaceutical companies for reasons frequently unrelated to or disproportionate to the operating performance of the specific companies. These broad market fluctuations may adversely affect the market price of our common stock.

Anti-takeover provisions in our charter documents, certain of our contracts with third parties, and under Delaware law could make an acquisition of us, even one that may be beneficial to our stockholders, more difficult and may prevent attempts by our stockholders to replace or remove our current management.

Provisions in our certificate of incorporation and by-laws may delay or prevent an acquisition of us or a change in our management. These provisions include the ability of our board of directors to issue preferred stock without stockholder approval. In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which limits the ability of stockholders owning in excess of 15% of our outstanding voting stock to merge or combine with us. Although we believe these provisions collectively provide for an opportunity to obtain greater value for stockholders by requiring potential acquirers to negotiate with our board of directors, they would apply even if an offer rejected by our board were considered beneficial by some stockholders. Additionally, certain of our contracts with third parties allow for termination upon specified change of control transactions. Anti-takeover provisions may frustrate or prevent any attempts by our stockholders to replace or remove our current management by making it more difficult for stockholders to replace members of our board of directors, which is responsible for appointing the members of our management, and anti-takeover or change of control contract termination rights may frustrate or prevent any attempts by a third party to acquire or attempt to acquire the Company.

Changes in accounting standards and subjective assumptions, estimates, and judgments by management related to complex accounting matters could significantly affect our financial results or financial condition.

Generally accepted accounting principles and related accounting pronouncements, implementation guidelines, and interpretations with regard to a wide range of matters that are relevant to our business, such as revenue recognition, asset impairment and fair value determinations, inventories, business combinations and intangible asset valuations, leases, and litigation, are highly complex and involve many subjective assumptions, estimates, and judgments. Changes in these rules or their interpretation or changes in underlying assumptions, estimates, or judgments could significantly change our reported or expected financial performance or financial condition.

Our results of operations could be negatively affected by potential fluctuations in foreign currency exchange rates.

We conduct a large portion of our business in international markets. For the fiscal year ended December 31, 2019, 29% of our revenues and 17% of our costs and expenses were denominated in foreign currencies, primarily the Swedish krona, the British pound sterling, and the Euro. We are exposed to the risk of an increase or decrease in the value of the foreign currencies relative to the U.S. Dollar, which could increase the value of our expenses and decrease the value of our revenue when measured in U.S. Dollars. As a result, our results of operation may be influenced by the effects of future exchange rate fluctuations and such effects may have an adverse impact on our common stock price.

Our ability to use net operating loss and tax credit carryforwards and certain built-in losses to reduce future tax payments is limited by provisions of the Internal Revenue Code, and it is possible that certain transactions or a combination of certain transactions may result in material additional limitations on our ability to use our net operating loss and tax credit carryforwards.

Section 382 and 383 of the Internal Revenue Code of 1986, as amended, contain rules that limit the ability of a company that undergoes an ownership change, which is generally any change in ownership of more than 50% of its stock over a three-year period, to utilize its net operating loss and tax credit carryforwards and certain built-in losses recognized in years after the ownership change. These rules generally operate by focusing on ownership changes involving stockholders owning directly or indirectly 5% or more of the stock of a company and any change in ownership arising from a new issuance of stock by the company. Generally, if an ownership change occurs, the yearly taxable income limitation on the use of net operating loss and tax credit carryforwards and certain built-in losses is equal to the product of the applicable long-term, tax-exempt rate and the value of the

company's stock immediately before the ownership change. We may be unable to offset our taxable income with losses, or our tax liability with credits, before such losses and credits expire and therefore would incur larger federal income tax liability. While our most recent Section 382 analysis did not show any current exposure, future transactions or combinations of future transactions may result in a change in control under Section 382 in the future.

If we fail to maintain an effective system of internal controls, we may not be able to accurately report financial results or prevent fraud. If we identify a material weakness in our internal control over financial reporting, our ability to meet our reporting obligations and the trading price of our stock could be negatively affected.

Effective internal controls are necessary to provide reliable financial reports and to assist in the effective prevention of fraud. Any inability to provide reliable financial reports or prevent fraud could harm our business. We regularly review and update our internal controls, disclosure controls and procedures, and corporate governance policies. In addition, we are required under the Sarbanes-Oxley Act of 2002 to report annually on our internal control over financial reporting. Any system of internal controls, however well designed and operated, is based in part on certain assumptions and can provide only reasonable, not absolute, assurances that the objectives of the system are met. If we, or our independent registered public accounting firm, determine that our internal controls over financial reporting are not effective, discover areas that need improvement in the future or discover a material weakness, these shortcomings could have an adverse effect on our business and financial results, and the price of our common stock could be negatively affected. A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a reasonable possibility that a material misstatement of our annual or interim financial statements will not be prevented or detected on a timely basis. Accordingly, a material weakness increases the risk that the financial information we report contains material errors.

If we cannot conclude that we have effective internal control over our financial reporting, or if our independent registered public accounting firm is unable to provide an unqualified opinion regarding the effectiveness of our internal control over financial reporting, investors could lose confidence in the reliability of our financial statements, which could lead to a decline in our stock price. Failure to comply with reporting requirements could also subject us to sanctions and/or investigations by the SEC, The Nasdaq Stock Market or other regulatory authorities. We have previously implemented several significant ERP modules and expect to implement additional ERP modules in the future. The implementation of the ERP system represents a change in our internal control over financial reporting. Although we continue to monitor and assess our internal controls in the new ERP system environment as changes are made and new modules are implemented, and we have taken additional steps to modify and enhance the design and effectiveness of our internal control over financial reporting, there is a risk that deficiencies may occur that could constitute significant deficiencies or in the aggregate a material weakness.

If we fail to remedy any deficiencies or maintain the adequacy of our internal controls, we could be subject to regulatory scrutiny, civil or criminal penalties or shareholder litigation. In addition, failure to maintain adequate internal controls could result in financial statements that do not accurately reflect our operating results or financial condition.

Our internal computer systems, or those of our customers, collaborators or other contractors, may be subject to cyber-attacks or security breaches, which could result in a material disruption of our product development programs.

Despite the implementation of security measures, our internal computer systems and those of our customers, collaborators and other contractors are vulnerable to damage from computer viruses and unauthorized access. Cyber-attacks are increasing in their frequency, sophistication and intensity, and have become increasingly difficult to detect. Cyber-attacks could include the deployment of harmful malware, ransomware,

denial-of-service attacks, social engineering and other means to affect service reliability and threaten the confidentiality, integrity and availability of information. Cyber-attacks also could include phishing attempts or e-mail fraud to cause payments or information to be transmitted to an unintended recipient. A material cyber-attack or security breach could cause interruptions in our operations and could result in a material disruption of our business operations, damage to our reputation or a loss of revenues.

In the ordinary course of our business, we collect and store sensitive data, including, among other things, personally identifiable information about our employees, intellectual property, and proprietary business information. Any cyber-attack or security breach that leads to unauthorized access, use or disclosure of personal or proprietary information could harm our reputation, cause us not to comply with federal and/or state breach notification laws and foreign law equivalents and otherwise subject us to liability under laws and regulations that protect the privacy and security of personal information. In addition, we could be subject to risks caused by misappropriation, misuse, leakage, falsification or intentional or accidental release or loss of information maintained in the information systems and networks of our company and our vendors, including personal information of our employees, and company and vendor confidential data. In addition, outside parties may attempt to penetrate our systems or those of our vendors or fraudulently induce our personnel or the personnel of our vendors to disclose sensitive information in order to gain access to our data and/or systems. Like other companies, we have on occasion experienced, and will continue to experience, data security incidents involving access to company data threats to our data and systems, including malicious codes and viruses, phishing, business email compromise attacks, or other cyber-attacks. The number and complexity of these threats continue to increase over time. If a material breach of our information technology systems or those of our vendors occurs, the market perception of the effectiveness of our security measures could be harmed and our reputation and credibility could be damaged.

We could be required to expend significant amounts of money and other resources to respond to these threats or breaches and to repair or replace information systems or networks and could suffer financial loss or the loss of valuable confidential information. In addition, we could be subject to regulatory actions and/or claims made by individuals and groups in private litigation involving privacy issues related to data collection and use practices and other data privacy laws and regulations, including claims for misuse or inappropriate disclosure of data, as well as unfair or deceptive practices. Although we develop and maintain systems and controls designed to prevent these events from occurring, and we have a process to identify and mitigate threats, the development and maintenance of these systems, controls and processes is costly and requires ongoing monitoring and updating as technologies change and efforts to overcome security measures become increasingly sophisticated. Moreover, despite our efforts, the possibility of these events occurring cannot be eliminated entirely and there can be no assurance that any measures we take will prevent cyber-attacks or security breaches that could adversely affect our business.

Legal, political and economic uncertainty surrounding the planned exit of the United Kingdom from the European Union is a source of instability and uncertainty.

In June 2016, a majority of the eligible members of the electorate in the United Kingdom voted to withdraw from the European Union in a national referendum, commonly referred to as “Brexit.” The United Kingdom and the European Union agreed to a withdrawal agreement (the “Withdrawal Agreement”). The Withdrawal Agreement was approved by the U.K. Parliament and the United Kingdom formally left the European Union on January 31, 2020. Under the Withdrawal Agreement, the United Kingdom is subject to a transition period until December 31, 2020 (the “Transition Period”), during which European Union rules will continue to apply.

Negotiations between the United Kingdom and the European Union are expected to continue in relation to the customs and trading relationship between the United Kingdom and the European Union following the expiry of the Transition Period.

The uncertainty concerning the United Kingdom’s legal, political and economic relationship with the European Union after the Transition Period may be a source of instability in the international markets, create significant

currency fluctuations, and/or otherwise adversely affect trading agreements or similar cross-border co-operation arrangements (whether economic, tax, fiscal, legal, regulatory or otherwise).

These developments, or the perception that any of them could occur, have had, and may continue to have, a significant adverse effect on global economic conditions and the stability of global financial markets, and could significantly reduce global market liquidity and limit the ability of key market participants to operate in certain financial markets. In particular, it could also lead to a period of considerable uncertainty in relation to the U.K. financial and banking markets, as well as on the regulatory process in Europe. Asset valuations, currency exchange rates and credit ratings may also be subject to increased market volatility.

If the United Kingdom and the EU are unable to negotiate acceptable trading and customs terms or if other EU Member States pursue withdrawal, barrier-free access between the United Kingdom and other EU Member States or among the European Economic Area ("E.E.A.") overall could be diminished or eliminated. The long-term effects of Brexit will depend on any agreements (or lack thereof) between the United Kingdom and the EU and, in particular, any arrangements for the United Kingdom to retain access to EU markets after the Transition Period. Such a withdrawal from the EU is unprecedented, and it is unclear how the U.K. access to the European single market for goods, capital, services and labor within the EU, or single market, and the wider commercial, legal and regulatory environment, will impact our U.K. operations.

We may also face new regulatory costs and challenges that could have an adverse effect on our operations and development programs. For example, the United Kingdom could lose the benefits of global trade agreements negotiated by the EU on behalf of its members, which may result in increased trade barriers that could make our doing business in the EU and the E.E.A. more difficult. There may continue to be economic uncertainty surrounding the consequences of Brexit, which could adversely affect our financial condition, results of operations, cash flows and market price of our common stock.

Natural disasters, geopolitical unrest, war, terrorism, public health issues or other catastrophic events could disrupt the supply, delivery or demand of products, which could negatively affect our operations and performance.

We are subject to the risk of disruption by earthquakes, floods and other natural disasters, fire, power shortages, geopolitical unrest, war, terrorist attacks and other hostile acts, public health issues, epidemics or pandemics and other events beyond our control and the control of the third parties on which we depend. Any of these catastrophic events, whether in the United States or abroad, may have a strong negative impact on the global economy, our employees, facilities, partners, suppliers, distributors or customers, and could decrease demand for our products, create delays and inefficiencies in our supply chain and make it difficult or impossible for us to deliver products to our customers.

For example, in December 2019 an outbreak of a novel strain of coronavirus originated in Wuhan, China, and has since spread to a number of other countries in which we or our suppliers operate, including the United States. This outbreak has resulted in the extended shutdown of certain businesses in the Wuhan region, which may in turn result in disruptions to our and our customer's supply chain and business operations. These could include disruptions from the temporary closure of third-party supplier and manufacturer facilities, interruptions in product supply, or restrictions on the export or shipment of our products. Global health concerns, such as coronavirus, could also result in social, economic, and labor instability in the countries in which we or our customers and suppliers operate. These uncertainties could have a material adverse effect on our business and our results of operation and financial condition.

In addition, a catastrophic event that results in the destruction or disruption of our data centers or our critical business or information technology systems would severely affect our ability to conduct normal business operations and, as a result, our operating results would be adversely affected.

Changes in laws and regulations governing the privacy and protection of data and personal information could adversely affect our business.

We are subject to data privacy and protection laws and regulations that apply to the collection, transmission, storage and use of proprietary information and personally-identifying information, which among other things, imposes certain requirements relating to the privacy, security and transmission of certain individually identifiable information. In addition, numerous other federal and state laws, including state security breach notification laws, state health information privacy laws and federal and state consumer protection laws, govern the collection, use, disclosure and security of personal information. These laws continue to change and evolve, and are increasing in breadth and impact. For example, the California Consumer Privacy Act grants consumers new rights with respect to their personal data, and provides for a private right of action for security breaches. This law and others like it are as yet untested and may subject the Company to increased regulatory scrutiny, litigation, and overall risk.

Various foreign countries also have, or are developing, laws governing the collection, use, disclosure, security, and cross-border transmission of personal information. The legislative and regulatory landscape for privacy and data protection continues to evolve, and there has been an increasing amount of focus on privacy and data protection issues with the potential to affect our business. For example, privacy requirements in the European Union ("EU") govern the transfer of personal information from the European Economic Area to the United States. While we continue to address the implications of changes to the EU data privacy regulations, the area remains an evolving landscape with new regulations coming into effect and continued legal challenges and our efforts to comply with the evolving data protection rules may be unsuccessful. Failure to comply with laws regarding data protection would expose us to risk of enforcement actions taken by data protection authorities in the EU and the potential for significant penalties if we are found to be non-compliant. Similarly, failure to comply with federal and state laws in the United States regarding privacy and security of personal information could expose us to penalties under such laws. Even if we are not determined to have violated these laws, government investigations into these issues typically require the expenditure of significant resources and generate negative publicity, which could harm our business.

Certain of our products are used by customers in the production of gene therapies, which represent a relatively new and still-developing mode of treatment. Unforeseen adverse events, negative clinical outcomes, or increased regulatory scrutiny of gene therapy and its financial cost may damage public perception of the safety, utility, or efficacy of gene therapies and may harm our customers' ability to conduct their business. Such events may negatively impact our revenues and have an adverse effect on our performance.

Gene therapy remains a relatively new and developing treatment method, with only a few gene therapies approved to date by regulatory authorities. Public perception may be influenced by claims that gene therapy is unsafe or ineffective, and gene therapy may not gain the acceptance of the public or the medical community. In addition, ethical, social, legal, and financial concerns about gene therapy and genetic testing could result in additional regulations or limitations or even prohibitions on certain gene therapies or gene-therapy-related products. More restrictive regulations or negative public perception could reduce certain of our customers' use of our products, which could negatively affect our revenue and performance.

ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

Our material office and manufacturing leases are detailed below:

Location	Square Feet	Principal Use	Lease Expiration
Waltham, Massachusetts	108,135[1]	Corporate headquarters, manufacturing, research and development, marketing and administrative offices	April 1, 2030
Rancho Dominguez, California	68,908	Manufacturing, research and development, marketing and administrative operations	November 30, 2025[2]
Marlborough, Massachusetts	63,761	Manufacturing operations	November 30, 2028
Lund, Sweden	45,381	Manufacturing and administrative operations	December 31, 2021
Bridgewater, New Jersey[3]	33,669	Manufacturing and administrative operations	January 14, 2029

(1) In 2019, we expanded our facility in Waltham, Massachusetts by approximately 33,000 square feet to accommodate additional office space and manufacturing.
(2) In 2018, we expanded our facility in Rancho Dominguez, California by approximately 15,000 square feet. The lease for the expanded portion of the facility expires on November 30, 2025.
(3) On May 31, 2019, we acquired C Technologies, an analytics company located in Bridgewater, New Jersey.

During the year ended December 31, 2019, we incurred total rental costs for all facilities of $6.0 million.

ITEM 3. LEGAL PROCEEDINGS

From time to time, we may be subject to legal proceedings and claims in the ordinary course of business. We are not currently aware of any such proceedings or claims that we believe will have, individually or in the aggregate, a material adverse effect on our business, financial condition or results of operations.

ITEM 4. MINE SAFETY DISCLOSURES

Not applicable.

PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

Market Information for Common Stock

Our common stock is traded on the Nasdaq Global Select Market under the symbol "RGEN."

Stockholders and Dividends

As of February 18, 2020, there were 338 stockholders of record of our common stock. We have not paid any dividends since our inception and do not intend to pay any dividends on our common stock in the foreseeable future. We anticipate that we will retain all earnings, if any, to support our operations. Any future determination as to the payment of dividends will be at the sole discretion of our Board of Directors and will depend on our financial condition, results of operations, capital requirements and other factors our Board of Directors deems relevant.

Equity Compensation Plan Information

The following table sets forth information as of December 31, 2019 regarding shares of common stock that may be issued under the Company's equity compensation plans, consisting of the Second Amended and Restated 2001 Repligen Corporation Stock Plan, the Amended and Restated 2012 Stock Option and Incentive Plan and the 2018 Stock Option and Incentive Plan.

Plan Category	Number of securities to be issued upon exercise of outstanding options, warrants and rights	Weighted-average exercise price of outstanding options, warrants and rights	Number of securities remaining available for future issuance under equity compensation plans (excluding securities reflected in column (a))
	(a)	(b)	(c)
Equity compensation plans approved by security holders	1,692,543[1]	$30.81[2]	2,555,281

(1) Includes 957,559 shares of common stock issuable upon the exercise of outstanding options and 734,984 shares of common stock issuable upon the vesting of stock units, which include restricted stock units and performance stock units. No shares of restricted stock are outstanding.

(2) Since stock units do not have any exercise price, such units are not included in the weighted average exercise price calculation.

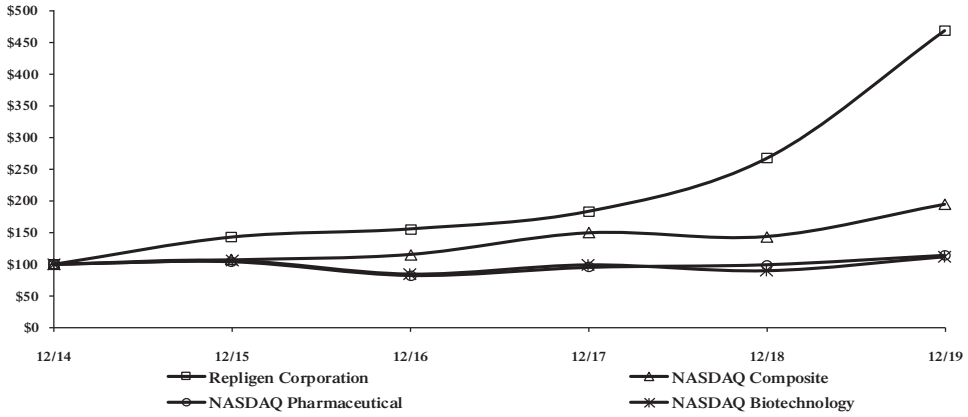
Issuer Purchases of Equity Securities

In June 2008, the Board of Directors authorized a program to repurchase up to 1.25 million shares of our common stock to be repurchased at the discretion of management from time to time in the open market or through privately negotiated transactions. The repurchase program has no set expiration date and may be suspended or discontinued at any time. We did not repurchase any shares of common stock during the year ended December 31, 2019. In prior years, we repurchased a total of 592,827 shares, leaving 657,173 shares remaining under this authorization.

The graph below matches Repligen Corporation's cumulative 5-year total shareholder return on common stock with the cumulative total returns of the NASDAQ Composite index, the NASDAQ Pharmaceutical index, and the NASDAQ Biotechnology index. The graph tracks the performance of a $100 investment in our common stock and in each index (with the reinvestment of all dividends) from December 31, 2014 to December 31, 2019.

COMPARISON OF 5 YEAR CUMULATIVE TOTAL RETURN*

Among Repligen Corporation, the NASDAQ Composite Index,
the NASDAQ Pharmaceutical Index and the NASDAQ Biotechnology Index



*$100 invested on 12/31/14 in stock or index, including reinvestment of dividends. Fiscal year ending December 31.

The information contained in the performance graph shall not be deemed to be "soliciting material" or to be "filed" with the SEC, and such information shall not be incorporated by reference into any future filing under the Securities Act of 1933, as amended (the "Securities Act") or the Securities Exchange Act of 1934, as amended (the "Exchange Act"), except to the extent that Repligen specifically incorporates it by reference into such filing.

ITEM 6. SELECTED CONSOLIDATED FINANCIAL DATA

The following selected consolidated financial data are derived from the audited consolidated financial statements of Repligen. The selected financial data set forth below should be read in conjunction with our consolidated financial statements and the related notes thereto and "Management's Discussion and Analysis of Financial Condition and Results of Operations" included elsewhere in this Annual Report on Form 10-K ("Form 10-K"), and in our Form 10-K's for the years ended December 31, 2019, 2018, 2017, 2016 and 2015.

	For the Years Ended December 31,				
	2019	2018[1]	2017[2]	2016	2015[3]
	(Amounts in thousands, except per share data)				
Revenue:					
Product revenue	$ 270,097	$193,891	$141,089	$104,441	$ 83,537
Royalty and other revenue	148	141	147	100	—
Total revenue	270,245	194,032	141,236	104,541	83,537
Operating costs and expenses:					
Cost of product revenue	119,099	86,531	67,050	47,117	35,251
Research and development	19,450	15,821	8,672	7,355	5,740
Selling, general and administrative	95,613	65,692	51,509	30,853	24,699
Contingent consideration – fair value adjustments	—	—	—	3,242	4,083
Total operating costs and expenses	234,162	168,044	127,231	88,567	69,773
Income from operations	36,083	25,988	14,005	15,974	13,764
Other expenses, net	(9,932)	(4,552)	(6,757)	(4,282)	(341)
Income before income taxes	26,151	21,436	7,248	11,692	13,423
Income tax provision (benefit)	4,740	4,819	(21,105)	11	4,078
Net income	$ 21,411	$ 16,617	$ 28,353	$ 11,681	$ 9,345
Earnings per share:					
Basic	$ 0.44	$ 0.38	$ 0.74	$ 0.35	$ 0.28
Diluted	$ 0.44	$ 0.37	$ 0.72	$ 0.34	$ 0.28
Weighted average shares outstanding:					
Basic	48,343	43,767	38,234	33,573	32,882
Diluted	49,206	45,471	39,150	34,099	33,577

	As of December 31,				
	2019	2018	2017	2016	2015
	(Amounts in thousands)				
Cash, cash equivalents and marketable securities[4]	$ 528,392	$193,822	$173,759	$141,780	$ 73,407
Working capital	593,515	145,897	217,571	163,078	84,471
Total assets[5]	1,400,113	774,621	743,519	288,913	146,237
Long-term obligations[5,6]	292,032	29,211	126,760	99,074	4,708
Accumulated earnings (deficit)	5,843	(15,568)	(31,508)	(59,861)	(71,542)
Total stockholders' equity	1,059,768	615,568	591,548	168,764	122,748

(1) Includes the full year impact of the acquisition of Spectrum Lifesciences, LLC on August 1, 2017

(2) Includes the full year impact of the acquisition of Atoll GmbH on April 1, 2016 and the acquisition of TangenX™ Technology Corporation on December 14, 2016.

(3) Includes the full year impact of the acquisition of Refine Technology on June 2, 2014.

(4) During 2019, the Company increased cash through public offerings of common stock on May 3, 2019 and July 19, 2019, which totaled aggregate net proceeds of $320.7 million. In addition, on July 19, 2019, the Company issued $287.5 million aggregate principal amount of 0.375% Convertible Senior Notes (the "2019 Notes") due 2024 for net proceeds of $278.5 million. The Company utilized approximately $115 million of the proceeds from the issuance of the 2019 Notes to settle its outstanding 2.125% Convertible Senior Notes due 2021 (the "2016 Notes").

(5) As a result of the adoption of new accounting guidance on January 1, 2019, we recognized lease assets and liabilities for operating leases with terms of more than twelve months. Prior period amounts were not adjusted and continue to be reported in accordance with historic accounting policies around leases. See Note 4, *"Leases,"* included in Item 15(a)(1) of Part IV, Exhibits and Financial Statement Schedules – Financial Statements, for additional information.

(6) Long-term obligations include the $232.8 million carrying value of the 2019 Notes as of December 31, 2019. See Note 11, *"Convertible Senior Notes,"* included in Item 15(a)(1) of Part IV, Exhibits and Financial Statement Schedules – Financial Statements, for additional information.

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

Information pertaining to fiscal year 2017 was included in the Company's Annual Report on Form 10-K ("Form 10-K") for the year ended December 31, 2018 on pages 30 through 43 under Part II, Item 7, "Management's Discussion and Analysis of Financial Condition and Results of Operations," which was filed with the SEC on March 1, 2019.

Repligen and its subsidiaries, collectively doing business as Repligen Corporation ("Repligen", "we", "our", or "the Company") is a global life sciences company that develops and commercializes highly innovated bioprocessing technology and systems that increase efficiencies and flexibility in the process of manufacturing biological drugs. As the overall market for biologics continues to grow and expand, our customers – primarily large biopharmaceutical companies and contract development and manufacturing organizations – face critical production cost, capacity, quality and time pressures. Built to address these concerns, our products helping set new standards for the way biologics are manufactured. We are committed to inspiring advances in bioprocessing as a trusted partner in the production of critical biologic drugs – including monoclonal antibodies, recombinant proteins, vaccines and gene therapies – that are improving human health worldwide.

Our Chromatography products feature pre-packed chromatography columns under our OPUS® brand. OPUS columns, which we deliver to our customers pre-packed with their choice of chromatography resin, are single-campaign ("single-use") disposable columns that replace the use of traditional (more permanent) glass columns used in downstream purification and quality control of biological drugs. By designing OPUS columns as an advanced and flexible option for the purification of biologics from process development through clinical-scale and some commercial manufacturing, Repligen has become a leader in pre-packed columns ("PPC").

Our Filtration products offer a number of advantages to manufacturers of biologic drugs at volumes that span from pilot studies to clinical and commercial-scale production. XCell ATF™ systems are alternating tangential flow ("ATF") and used primarily in upstream perfusion (continuous manufacturing) processes to increase cell concentration and significantly improve biologic product yield from a bioreactor. To address increasing industry demand for "plug-and-play" technology, we developed and launched single-use formats of the original stainless steel XCell ATF device. In December 2016, we acquired TangenX Technology Corporation ("TangenX"), balancing our upstream XCell ATF offering with a downstream portfolio of TangenX™ Flat Sheet Cassettes used in biologic drug purification and formulation processes. The TangenX portfolio includes the single-use SIUS™ TFF cassettes, providing customers with a high-performance, low-cost alternative to reusable TFF cassettes. We acquired Spectrum Life Sciences LLC ("Spectrum") and its subsidiaries in August 2017 to strengthen our filtration business with the addition of a leading portfolio of Spectrum® Hollow Fibers. Spectrum brands include the KrosFlo® TFF systems with Konduit monitor and ProConnex® single-use, flow-path assemblies. We also gained the Spectra/Por® portfolio of laboratory and process dialysis products and in 2019, we launched the SpectraFlo™ Dynamic Dialysis Systems, and the KrosFlo® TFDF™ (Tangential Flow Depth Filtration) Systems, which we believe has the potential to disrupt and displace transitional harvest clarification operations. With the acquisition of Spectrum, we substantially increased our direct sales presence in Europe and Asia, and we diversified our end markets beyond monoclonal antibodies ("mAb") to include vaccines, recombinant proteins and gene therapies.

We are a leading supplier of Protein A affinity ligands to life sciences companies. Protein A affinity ligands are an essential "binding" component of Protein A chromatography resins used in the purification of virtually all mAb-based drugs on the market or in development. We manufacture multiple forms of Protein A affinity ligands under long-term supply agreements with major life sciences companies who in turn sell their Protein A chromatography resins to end users (mAb manufacturers).

Customers use our products to produce initial quantities of drug for clinical studies and then scale-up to larger volumes as the drug progresses to commercial production following regulatory approval. Detailed specifications

for a drug's manufacturing process are included in the applications that biopharmaceutical companies file for marketing approval with regulators, such as the U.S. Food and Drug Administration and the European Medicines Agency, throughout the clinical trial process and prior to final commercial approval. As a result, products that become part of the manufacturing specifications of a late-stage clinical or commercial process can be very sensitive given the costs and uncertainties associated with displacing them.

C Technologies, Inc. Acquisition

On April 25, 2019, we entered into a Stock Purchase Agreement ("Purchase Agreement") with C Technologies, Inc. ("C Technologies"), a New Jersey corporation, and Craig Harrison, an individual and sole stockholder of C Technologies. The deal was consummated on May 31, 2019 (the "C Technologies Acquisition").

C Technologies sells instruments, consumables and accessories that are designed to allow bioprocessing technicians to measure the protein concentration of a liquid sample using C Technologies' Slope Spectroscopy® method, which eliminates the need for manual sample dilution. C Technologies' lead product, the SoloVPE® Device, was launched in 2008 for off-line and at-line protein concentration measurements conducted in quality control, process development and manufacturing labs in the production of biological therapeutics. C Technologies' FlowVPE® Device, an extension of the SoloVPE technology, was designed to allow end users to make in-line protein concentration measurements in filtration, chromatography and fill-finish applications, designed to allow for real-time process monitoring.

The C Technologies Acquisition was accounted for as a purchase of a business under Accounting Standard Codification No. ("ASC") 805, *"Business Combinations."* The cash paid for the C Technologies Acquisition was $195.0 million, $186.0 million of which will be consideration transferred pursuant to ASC 805, and $9.0 million of which will be compensation expense for future employment, and 779,221 of unregistered common shares totaling $53.9 million (based on a per share price of $69.22), for a total purchase price of $239.9 million.

Critical Accounting Policies and Estimates

While our significant accounting policies are more fully described in the notes to our consolidated financial statements, we have identified the policies and estimates below as being critical to our business operations and the understanding of our results of operations. These policies require management's most difficult, subjective or complex judgements, often as a result of the need to make estimates about the effect of matters that are inherently uncertain. The impact of and any associated risks related to these policies on our business operations are discussed throughout "Management's Discussion and Analysis of Financial Condition," including in the "Results of Operations" section, where such policies affect our reported and expected financial results. Although we believe that our estimates, assumptions, and judgements are reasonable, they are based upon information presently available. Actual results may differ significantly from these estimates under different assumptions, judgments, or conditions.

Revenue recognition

We generate revenue from the sale of bioprocessing products, equipment devices, and related consumables used with these equipment devices to customers in the life science and biopharmaceutical industries. Under ASC 606, "*Revenue from Contracts with Customers,"* revenue is recognized when, or as, obligations under the terms of a contract are satisfied, which occurs when control of the promised products or services is transferred to customers. Revenue is measured as the amount of consideration the Company expects to receive in exchange for transferring products or services to a customer ("transaction price"). To the extent the transaction price includes variable consideration, the Company estimates the amount of variable consideration that should be included in the transaction price utilizing the expected value method or the most likely amount method, depending on the facts and circumstances relative to the contract. Variable consideration is included in the transaction price if, in the Company's judgment, it is probable that a significant future reversal of cumulative revenue under the contract

will not occur. Estimates of variable consideration and determination of whether to include estimated amounts in the transaction price are based largely on an assessment of the Company's anticipated performance and all information (historical, current and forecasted) that is reasonably available. Sales, value add, and other taxes collected on behalf of third parties are excluded from revenue.

When determining the transaction price of a contract, an adjustment is made if payment from a customer occurs either significantly before or significantly after performance, resulting in a significant financing component. Applying the practical expedient in paragraph 606-10-32-18, the Company does not assess whether a significant financing component exists if the period between when the Company performs its obligations under the contract and when the customer pays is one year or less. None of the Company's contracts contained a significant financing component as of December 31, 2019.

Contracts with customers may contain multiple performance obligations. For such arrangements, the transaction price is allocated to each performance obligation based on the estimated relative standalone selling prices of the promised products or services underlying each performance obligation. The Company determines standalone selling prices based on the price at which the performance obligation is sold separately. If the standalone selling price is not observable through past transactions, the Company estimates the standalone selling price taking into account available information such as market conditions and internally approved pricing guidelines related to the performance obligations.

The Company recognizes product revenue under the terms of each customer agreement upon transfer of control to the customer, which occurs at a point in time.

Inventories

We value inventory at cost or, if lower, net realizable value, using the first-in, first-out method. We review our inventory at least quarterly and record a provision for excess and obsolete inventory based on our estimates of expected sales volume, production capacity and expiration dates of raw materials, work-in-process and finished products. Expected sales volumes are determined based on supply forecasts provided by key customers for the next three to 12 months. We write down inventory that has become obsolete, inventory that has a cost basis in excess of its expected net realizable value, and inventory in excess of expected requirements to cost of product revenue. Manufacturing of bioprocessing finished goods is done to order and tested for quality specifications prior to shipment.

A change in the estimated timing or amount of demand for our products could result in additional provisions for excess inventory quantities on hand. Any significant unanticipated changes in demand or unexpected quality failures could have a significant impact on the value of inventory and reported operating results. During all periods presented in the accompanying consolidated financial statements, there have been no material adjustments related to a revised estimate of inventory valuations.

Business combinations

Amounts paid for acquisitions are allocated to the tangible and intangible assets acquired and liabilities assumed, if any, based on their fair values at the dates of acquisition. This purchase price allocation process requires management to make significant estimates and assumptions with respect to intangible assets and deferred revenue obligations. The fair value of identifiable intangible assets is based on detailed valuations that use information and assumptions determined by management. Any excess of purchase price over the fair value of the net tangible and intangible assets acquired is allocated to goodwill. While we use our best estimates and assumptions to accurately value assets acquired and liabilities assumed at the acquisition date as well as any contingent consideration, where applicable, our estimates are inherently uncertain and subject to refinement. As a result, during the measurement period, which may be up to one year from the acquisition date, we record adjustments to the assets acquired and liabilities assumed with the corresponding offset to goodwill. Upon

conclusion of the measurement period or final determination of the values of assets acquired or liabilities assumed, whichever comes first, any subsequent adjustments are recorded to our consolidated statements of comprehensive income. The fair value of contingent consideration includes estimates and judgments made by management regarding the probability that future contingent payments will be made, the extent of royalties to be earned in excess of the defined minimum royalties, etc. Management updates these estimates and the related fair value of contingent consideration at each reporting period based on the estimated probability of achieving the earnout targets and applying a discount rate that captures the risk associated with the expected contingent payments. To the extent our estimates change in the future regarding the likelihood of achieving these targets we may need to record material adjustments to our accrued contingent consideration. Changes in the fair value of contingent consideration are recorded in our consolidated statements of comprehensive income.

We use the income approach to determine the fair value of certain identifiable intangible assets including customer relationships and developed technology. This approach determines fair value by estimating after-tax cash flows attributable to these assets over their respective useful lives and then discounting these after-tax cash flows back to a present value. We base our assumptions on estimates of future cash flows, expected growth rates, expected trends in technology, etc. We base the discount rates used to arrive at a present value as of the date of acquisition on the time value of money and certain industry-specific risk factors. We believe the estimated purchased customer relationships, developed technologies, trademark / tradename, patents, and in process research and development amounts so determined represent the fair value at the date of acquisition and do not exceed the amount a third party would pay for the assets.

Intangible assets and goodwill

Intangible assets

Intangible assets with a definite life are amortized over their useful lives using the straight-line method and the amortization expense is recorded within cost of product revenue and selling, general and administrative expense in the consolidated statements of comprehensive income. Intangible assets and their related useful lives are reviewed at least annually to determine if any adverse conditions exist that would indicate the carrying value of these assets may not be recoverable. More frequent impairment assessments are conducted if certain conditions exist, including a change in the competitive landscape, any internal decisions to pursue new or different technology strategies, a loss of a significant customer, or a significant change in the marketplace, including changes in the prices paid for the Company's products or changes in the size of the market for the Company's products. If impairment indicators are present, the Company determines whether the underlying intangible asset is recoverable through estimated future undiscounted cash flows. If the asset is not found to be recoverable, it is written down to the estimated fair value of the asset based on the sum of the future discounted cash flows expected to result from the use and disposition of the asset. If the estimate of an intangible asset's remaining useful life is changed, the remaining carrying amount of the intangible asset is amortized prospectively over the revised remaining useful life. The Company continues to believe that its definite-lived intangible assets are recoverable at December 31, 2019.

Indefinite-lived intangible assets are tested for impairment at least annually. There has been no impairment of our intangible assets for the periods presented.

Goodwill

We test goodwill for impairment on an annual basis and between annual tests if events and circumstances indicate it is more likely than not that the fair value of a reporting unit is less than its carrying value. Events that would indicate impairment and trigger an interim impairment assessment include, but are not limited to, current economic and market conditions, including a decline in market capitalization, a significant adverse change in legal factors, business climate or operational performance of the business, and an adverse action or assessment by a regulator. Goodwill is tested for impairment as of December 31st of each year, or more frequently as warranted

by events or changes in circumstances mentioned above. Accounting guidance also permits an optional qualitative assessment for goodwill to determine whether it is more likely than not that the carrying value of a reporting unit exceeds its fair value. If, after this qualitative assessment, we determine that it is not more likely than not that the fair value of a reporting unit is less than its carrying amount, then no further quantitative testing would be necessary. A quantitative assessment is performed if the qualitative assessment results in a more likely than not determination or if a qualitative assessment is not performed. The quantitative assessment considers whether the carrying amount of a reporting unit exceeds its fair value, in which case an impairment charge is recorded to the extent the reporting unit's carrying value exceeds its fair value.

As of December 31, 2018, the Company concluded that it operated as two reporting units and performed the 2018 goodwill impairment test using two reporting units. In 2019, the Company reorganized its reporting structure and changed the way the Chief Operating Decision Maker ("CODM") views the Company's operations and allocates its resources. As a result of the change in reporting structure in 2019, the CODM reviews consolidated results to assist with decision making. Accordingly, the Company operates as one reporting unit as of the goodwill impairment measurement date of December 31, 2019. The fair value of the reporting unit is determined using both an income approach and market approach. Our income approach model used for our reporting unit valuation is consistent with that used for our December 31, 2018 goodwill impairment valuation noted above except that cash flows from the entire business enterprise are used for the reporting unit valuation. Our market approach model estimates the fair value of the reporting unit based on market prices paid in actual precedent transactions of similar businesses and market multiples of guideline public companies. As a result of our 2019 quantitative assessment, we concluded that goodwill is not impaired as of December 31, 2019.

Accrued liabilities

We estimate accrued liabilities by identifying services performed on our behalf, estimating the level of service performed and determining the associated cost incurred for such service as of each balance sheet date. For example, we would accrue for professional and consulting fees incurred with law firms, audit and accounting service providers and other third-party consultants. These expenses are determined by either requesting those service providers to estimate unbilled services at each reporting date for services incurred or tracking costs incurred by service providers under fixed fee arrangements.

We have processes in place to estimate the appropriate amounts to record for accrued liabilities, which principally involve the applicable personnel reviewing the services provided. In the event that we do not identify certain costs that have begun to be incurred or we under or over-estimate the level of services performed or the costs of such services, the reported expenses for that period may be too low or too high. The date on which certain services commence, the level of services performed on or before a given date, and the cost of such services often require the exercise of judgment. We make these judgments based upon the facts and circumstances known at the date of the financial statements.

A change in the estimated cost or volume of services provided could result in additional accrued liabilities. Any significant unanticipated changes in such estimates could have a significant impact on our accrued liabilities and reported operating results. There have been no material adjustments to our accrued liabilities in any of the periods presented in the accompanying consolidated financial statements.

Debt accounting

Our long-term debt balance is related to our 0.375% Convertible Senior Notes due 2024 (the "2019 Notes"), which were issued in July 2019 and are carried at their principal amount less unamortized debt discount. We account for our convertible notes as separate liability and equity components. We estimate the carrying amount of the liability component by estimating the fair value of a similar liability that does not have an associated conversion feature. The Company allocates transaction costs related to the issuance of convertible notes to the liability and equity components using the same proportions as the initial carrying value of the convertible notes.

The carrying value of the equity component is calculated by deducting the carrying value of the liability component from the principal amount of the convertible notes as a whole. The difference represents a debt discount that is amortized to interest expense in our consolidated statement of comprehensive income over the term of the convertible notes using the effective interest rate method. We assess the equity classification of the cash conversion feature quarterly. We allocated transaction costs related to the issuance of the 2019 Notes to the liability and equity components using the same proportions as the initial carrying value of the 2019 Notes.

Stock-based compensation

We use the Black-Scholes option pricing model to calculate the fair value of stock option awards on the grant date. The expected term of options granted represents the period of time for which the options are expected to be outstanding and is derived from our historical stock option exercise experience and option expiration data. For purposes of estimating the expected term, we have aggregated all individual option awards into one group, as we do not expect substantial differences in exercise behavior among our employees. The expected volatility is a measure of the amount by which our stock price is expected to fluctuate during the expected term of options granted. We determined the expected volatility based upon the historical volatility of our common stock over a period commensurate with the option's expected term. The risk-free interest rate is the implied yield available on U.S. Treasury zero-coupon issues with a remaining term equal to the option's expected term on the grant date. We have never declared or paid any cash dividends on any of our capital stock and do not expect to do so in the foreseeable future. Accordingly, we use an expected dividend yield of zero to calculate the grant-date fair value of a stock option.

The fair value of stock units, which includes restricted stock units and performance stock units, is calculated using the closing price of the Company's common stock on the date of grant. We recognize compensation expense on awards that vest based on service conditions on a straight-line basis over the requisite service period based upon the number of options that are ultimately expected to vest, and accordingly, such compensation expense has been adjusted by an amount of estimated forfeitures. We recognize compensation expense on awards that vest based on performance conditions following our assessment of the probability that the performance condition will be achieved over the service period. Forfeitures represent only the unvested portion of a surrendered option. Forfeitures are estimated at the time of grant and revised, if necessary, in subsequent periods if actual forfeitures differ from those estimates. Based on an analysis of historical data, we have calculated an 8% annual forfeiture rate for non-executive level employees, a 3% annual forfeiture rate for executive level employees, and a 0% forfeiture rate for non-employee members of the Board of Directors, which we believe are reasonable assumptions to estimate forfeitures. However, the estimation of forfeitures requires significant judgment and, to the extent actual results or updated estimates differ from our current estimates, such amounts will be recorded as a cumulative adjustment in the period estimates are revised.

For the years ended December 31, 2019, 2018 and 2017, we recorded stock-based compensation expense of $12.8 million, $10.2 million and $6.7 million, respectively, for share-based awards granted under all of the Company's stock plans.

As of December 31, 2019, there was $36.4 million of total unrecognized compensation cost related to unvested share-based awards. This cost is expected to be recognized over a weighted average remaining requisite service period of 4.09 years. We expect 1,688,497 unvested options and stock units to vest over the next five years.

Income taxes

Deferred taxes are determined based on the difference between the financial statement and tax basis of assets and liabilities using enacted tax rates in effect in the years in which the differences are expected to reverse. Valuation allowances are provided, if, based upon the weight of available evidence, it is more likely than not that some or all of the deferred tax assets will not be realized. We account for uncertain tax positions using a "more-likely-than-not" threshold for recognizing and resolving uncertain tax positions. The evaluation of uncertain tax

positions is based on factors including, but not limited to, changes in tax law, the measurement of tax positions taken or expected to be taken in tax returns, the effective settlement of matters subject to audit, new audit activity and changes in facts or circumstances related to a tax position. We evaluate our tax position on a quarterly basis. We also accrue for potential interest and penalties related to unrecognized tax benefits in income tax expense.

In addition, we are subject to the continual examination of our income tax returns by the U.S. Internal Revenue Service ("IRS") and other domestic and foreign tax authorities. We expect future examinations to focus on our intercompany transfer pricing practices as well as other matters. We regularly assess the likelihood of outcomes resulting from these examinations to determine the adequacy of our provision for income taxes and have reserved for potential adjustments that may result from such examinations. We believe such estimates to be reasonable; however, the final determination of any of these examinations could significantly impact the amounts provided for income taxes in our consolidated financial statements.

Recent accounting standards update

See Note 2, *"Summary of Significant Accounting Policies – Recent Accounting Standards Updates,"* to our consolidated financial statements included in this report for more information.

Results of Operations

The following discussion of the financial condition and results of operations should be read in conjunction with the accompanying consolidated financial statements and the related footnotes thereto.

Revenues

Total revenues for years ended December 31, 2019, 2018, and 2017 were comprised of the following:

	For the Years Ended December 31,			2019 vs. 2018		2018 vs. 2017	
	2019	2018	2017	$ Change	% Change	$ Change	% Change
	(Amounts in thousands, except for percentage data)						
Revenue:							
Product	$270,097	$193,891	$141,089	$76,206	39.3%	$52,802	37.4%
Royalty and other	148	141	147	7	5.0%	(6)	(4.1%)
Total revenue	$270,245	$194,032	$141,236	$76,213	39.3%	$52,796	37.4%

Product revenues

Since 2016, we have been increasingly focused on selling our products directly to customers in the pharmaceutical industry and to our contract manufacturers. These direct sales have increased to approximately 76% of our product revenue during 2019. We expect that direct sales will continue to account for an increasing percentage of our product revenues, as the largest customer of our OEM products diversifies its supply chain starting in 2020. Sales of our bioprocessing products can be impacted by the timing of large-scale production orders and the regulatory approvals for such antibodies, which may result in significant quarterly fluctuations.

Product revenues were comprised of the following:

	For the Years Ended December 31,		
	2019[1]	2018	2017[2]
	(Amounts in thousands)		
Chromatography products	$ 64,635	$ 45,326	$ 36,309
Filtration products	119,534	90,586	49,050
Process analytics products	16,405	—	—
Proteins products	65,124	54,375	53,969
Other	4,399	3,604	1,761
Total product revenue	$270,097	$193,891	$141,089

(1) 2019 revenue includes process analytics revenue related to C Technologies from June 1, 2019 through December 31, 2019.

(2) 2017 revenue for filtration, chromatography and other products includes revenue related to Spectrum from August 1, 2017 through December 31, 2017.

Revenue from our chromatography products includes the sale of our OPUS chromatography columns, chromatography resins and ELISA test kits. Revenue from our filtration products includes the sale of our XCell ATF systems and consumables, KrosFlo filtration products and SIUS filtration products. Revenue from protein products includes the sale of our Protein A ligands and cell culture growth factors. Revenue from our Process Analytics products includes the sale of our SoloVPE and FlowVPE systems and consumables. Other revenue primarily consists of revenue from the sale of our operating room products to hospitals as well as freight revenue.

For 2019, product revenue increased by $76.2 million, or 39%, as compared to 2018. The increase is due to the continued adoption of our products by our key bioprocessing customers, particularly our chromatography and filtration products. Sales of our bioprocessing products are impacted by the timing of orders, development efforts at our customers or end-users and regulatory approvals for biologics that incorporate our products, which may result in significant quarterly fluctuations. Such quarterly fluctuations are expected, but they may not be predictive of future revenue or otherwise indicate a trend. Additionally, there was a $16.4 million increase in the 2019 revenue compared to the 2018 revenue due to revenues generated by C Technologies.

For 2018, product revenue increased by $52.8 million, or 37%, as compared to 2017. The increase is due to the continued adoption of our products by our key bioprocessing customers and a full year of revenues derived from our acquisition of Spectrum in August 2017.

Royalty revenues

Royalty revenues in 2019 and 2018 relate to royalties received from a third-party systems manufacturer associated with our OPUS chromatography columns. Royalty revenues are variable and are dependent on sales generated by our partner.

Costs and operating expenses

Total costs and operating expenses for years ended December 31, 2019, 2018 and 2017 were comprised of the following:

	For the Years Ended December 31,			2019 vs. 2018		2018 vs. 2017	
	2019	2018	2017	$ Change	% Change	$ Change	% Change
	(Amounts in thousands, except for percentage data)						
Cost of product revenue	$119,099	$ 86,531	$ 67,050	$32,568	37.6%	$19,481	29.1%
Research and development	19,450	15,821	8,672	3,629	22.9%	7,149	82.4%
Selling, general and administrative	95,613	65,692	51,509	29,921	45.5%	14,183	27.5%
Total costs and operating expenses	$234,162	$168,044	$127,231	$66,118	39.3%	$40,813	32.1%

Cost of product revenue

For 2019 and 2018, cost of product revenue increased $32.6 million, or 38%, and $19.5 million, or 29%, respectively, as compared to 2018 and 2017, due primarily to the increase in revenue mentioned above. Gross margins may fluctuate in future quarters based on expected production volume and product mix.

Gross margins were 56%, 55%, and 53% for 2019, 2018 and 2017, respectively. The gross margin in 2019 includes $1.5 million of amortization on an inventory step-up recorded in purchase accounting related to the C Technologies Acquisition. The increase in gross margins is a result of higher product revenue mentioned above offset by an increase in costs associated with additional manufacturing headcount in 2019, as compared to 2018. Gross margins may fluctuate in future quarters based on expected production volume and product mix. During 2018, gross margins increased compared to 2017 primarily due to higher product revenue.

Research and development expenses

During 2019, 2018 and 2017, research and development ("R&D") expenses were related to bioprocessing products, including personnel, supplies and other research expenses. Due to the size of the Company and the fact that these various programs share personnel and fixed costs, we do not track all of our expenses or allocate any fixed costs by program, and therefore, have not provided historical costs incurred by project. In addition to the legacy product research and development, the current single-use XCell ATF technology incurs expenses related to product development, sterilization, validation testing, and other research related expenses.

R&D expenses increased $3.6 million in 2019, or 23%, compared to 2018. The increase is primarily due to an increase in costs associated with an increase in R&D headcount, an increase in stock-based compensation expense resulting from the increased headcount and the higher share price period over period, and to the addition of $1.7 million of R&D expenses related to C Technologies, which was acquired in May 2019.

The increase in 2019 was partially offset by a $1.4 million decrease in R&D expense for investments made to expand our proteins product offering through our development agreement with Navigo Proteins GmbH ("Navigo"). The Company invested $1.0 million in 2019 compared to $2.4 million in 2018.

For 2018, R&D expenses increased by $7.1 million, or 82%, as compared to 2017. This increase is primarily driven by investments made during 2018 to expand our proteins product offerings through our development agreement with Navigo. Additionally, the increase is related to product development activities acquired as part of the Spectrum acquisition and increased activity in our various bioprocessing development projects.

We expect our R&D expenses in the year ending December 31, 2020 to increase in order to support new product development.

Selling, general and administrative expenses

Selling, general and administrative ("SG&A") expenses include the costs associated with selling our commercial products and costs required to support our marketing efforts, including legal, accounting, patent, shareholder services, amortization of intangible assets and other administrative functions.

For 2019, SG&A costs increased by $29.9 million, or 46%, as compared to 2018. The increase is due to the addition of $10.9 million of SG&A costs from the acquisition of C Technologies in May 2019, as well as the continued expansion of our customer-facing activities to drive sales of our bioprocessing products, and to the continued buildout of our administrative infrastructure, primarily through increased headcount, to support expected future growth. In addition, during 2019, transaction fees related to the C Technologies Acquisition of $4.0 million were included in SG&A, for which there were no comparable costs for 2018. Sales commissions were higher in 2019 due to the increase in revenue. Stock compensation expense increased as compared to 2018 resulting from the increase in headcount and higher share prices period over period.

For 2018, SG&A costs increased by $14.2 million, or 28%, as compared to 2017. The increase is due to selling and administrative activities incurred following the Spectrum acquisition, as well as the continued buildout of our administrative infrastructure to support expected future growth and continued expansion of our customer-facing activities to drive sales of our bioprocessing products.

Other expenses, net

The table below provides detail regarding our other expenses, net:

	For the Years Ended December 31,			2019 vs. 2018		2018 vs. 2017	
	2019	2018	2017	$ Change	% Change	$ Change	% Change
	(Amounts in thousands, except for percentage data)						
Investment income	$ 5,324	$ 1,895	$ 371	$ 3,429	180.9%	$1,524	410.8%
Loss on extinguishment of debt	(5,650)	—	—	(5,650)	100.0%	—	N/A
Interest expense	(9,292)	(6,709)	(6,441)	(2,583)	38.5%	(268)	4.2%
Other (expenses) income	(314)	262	(687)	(576)	(219.8%)	949	(138.1%)
Total other expenses, net	$(9,932)	$(4,552)	$(6,757)	$(5,380)	118.2%	$2,205	(32.6%)

Investment income

Investment income includes income earned on invested cash balances. The increase of $3.4 million for 2019 and $1.5 million for 2018, as compared to 2018 and 2017 was attributable to higher average invested cash balances and higher interest rates on such invested cash balances. We expect investment income to vary based on changes in the amount of funds invested and fluctuation of interest rates.

Loss on extinguishment of debt

The $5.7 million loss on extinguishment of debt for the year ended December 31, 2019 resulted from the settlement of our outstanding 2.125% Convertible Senior Notes due 2021 (the "2016 Notes") in the third quarter of 2019. The loss represents the difference between (i) the fair value of the liability component and (ii) the sum of the carrying value of the debt component and any unamortized debt issuance costs at the time of settlement.

Interest expense

Interest expense primarily includes interest related to our issuance of the 2016 Notes in May 2016, which were settled during the third quarter of 2019, and our issuance of 0.375% Convertible Senior Notes due 2024 (the "2019 Notes"), which were issued in July 2019. Interest expense increased $2.6 million in 2019, as compared to

2018. Interest calculated based on the carrying value related to the 2016 Notes was $1.3 million in 2019, compared to $2.4 million in 2018. As aforementioned, the 2016 Notes were settled during July 2019. As a result, interest was no longer accrued on the 2016 Notes subsequent to their settlement. Interest calculated based on the carrying value related to the 2019 Notes for 2019 was $0.5 million and there was no comparable amount for 2018.

The amortization of the debt issuance costs on the 2016 Notes was $2.8 million for 2019, compared to $4.5 million for 2018. The decrease in this amortization is a result of the settlement of the 2016 Notes and subsequent write-off of the remaining debt issuance costs in July 2019. Amortization of debt issuance costs on the 2019 Notes was $4.7 million in 2019. There were no comparable amounts in 2018 as the 2019 Notes were issued in July 2019.

Other (expenses) income

Changes in other (expenses) income during 2019, compared to 2018, are primarily attributable to foreign currency losses related to amounts due from non-Swedish krona-based customers and cash balance denominated in U.S. dollars and British pounds held by Repligen Sweden AB. In addition, $0.5 million was included in other (expenses) income in 2019, which represents a bridge loan commitment fee incurred as part of the C Technologies Acquisition.

Provision for income taxes

Income tax provision for the years ended December 31, 2019, 2018 and 2017 was as follows:

	For the Years Ended December 31,			2019 vs. 2018		2018 vs. 2017	
	2019	2018	2017	$ Change	% Change	$ Change	% Change
	(Amounts in thousands, except for percentage data)						
Income tax provision	$4,740	$4,819	$(21,105)	$(79)	(1.6%)	$25,924	(122.8%)
Effective tax rate	18.1%	22.5%	(291.2%)				

For the year ended December 31, 2019, we recorded an income tax provision of approximately $4.7 million. The effective tax rate was an income tax provision of 18.1% and is based upon the estimated taxable income for the year ending December 31, 2019 and the composition of the taxable income in different jurisdictions. The effective tax rate was lower than the U.S. statutory rate of 21% due primarily to windfall benefits on stock option exercises and the vesting of restricted stock units and to deductions related to debt extinguishment.

For the year ended December 31, 2018, we recorded an income tax provision of $4.8 million. The effective tax rate was 22.5% in 2018 and is based upon the estimated income from the year and the composition of the income in different jurisdictions. The effective tax rate was higher than the U.S. statutory rate of 21% due to state tax effects and the impact of the Global Intangible Low-Taxed Income tax enacted as part of the Tax Cuts and Jobs Act (the "2017 Tax Act") enacted in December 2017.

Non-GAAP Financial Measures

We provide non-GAAP adjusted income from operations, non-GAAP adjusted net income and adjusted EBITDA as supplemental measures to GAAP measures regarding our operating performance. These financial measures exclude the impact of certain acquisition related items and, therefore, have not been calculated in accordance with GAAP. A detailed explanation and a reconciliation of each non-GAAP financial measures to its most comparable GAAP financial measures are described below.

We include this financial information because we believe these measures provide a more accurate comparison of our financial results between periods and more accurately reflect how management reviews its financial results.

We excluded the impact of certain acquisition related items because we believe that the resulting charges do not accurately reflect the performance of our ongoing operations for the period in which such charges are incurred.

Non-GAAP adjusted income from operations

Non-GAAP adjusted income from operations is measured by taking income from operations as reported in accordance with GAAP and excluding acquisition and integration costs, inventory step-up charges, intangible amortization and contingent consideration expenses booked through our consolidated statements of comprehensive income. The following is a reconciliation of income from operations in accordance with GAAP to non-GAAP adjusted income from operations for the years ended December 31, 2019 and 2018:

	For the Years Ended December 31,	
	2019	2018
	(Amounts in thousands)	
GAAP income from operations	$36,083	$25,988
Non-GAAP adjustments to income from operations:		
Acquisition and integration costs	12,508	2,928
Inventory step-up charges	1,483	—
Intangible amortization	13,441	10,518
Non-GAAP adjusted income from operations	$63,515	$39,434

Non-GAAP adjusted net income

Non-GAAP adjusted net income is measured by taking net income as reported in accordance with GAAP and excluding acquisition and integration costs and related tax effects, inventory step-up charges, contingent consideration expenses, intangible amortization and related tax effects, non-cash interest expense, the partial release of the valuation allowance on our deferred tax assets and the net impact of tax reform legislation booked through our consolidated statements of comprehensive income. The following is a reconciliation of net income in accordance with GAAP to non-GAAP adjusted net income for the years ended December 31, 2019 and 2018:

	For the Years Ended December 31,			
	2019		2018	
	Amount	Fully Diluted Earnings per Share*	Amount	Fully Diluted Earnings per Share*
	(Amounts in thousands, except per share data)			
GAAP net income	$ 21,411	$ 0.44	$16,617	$ 0.37
Non-GAAP adjustments to net income:				
Acquisition and integration costs	13,008	0.26	2,928	0.06
Inventory step-up charges	1,483	0.03	—	—
Intangible amortization	13,441	0.27	10,518	0.23
Loss on extinguishment of debt	5,650	0.11	—	—
Non-cash interest expense	7,536	0.15	4,248	0.09
Tax effect of intangible amortization and acquisition costs	(10,003)	(0.20)	(4,204)	(0.09)
Non-GAAP adjusted net income	$ 52,526	$ 1.07	$30,107	$ 0.66

* Note that earnings per share amounts may not add due to rounding.

Adjusted EBITDA

Adjusted EBITDA is measured by taking net income as reported in accordance with GAAP, excluding investment income, interest expense, taxes, depreciation and intangible amortization, and excluding acquisition and integration costs, inventory step-up charges and contingent consideration expenses booked through our consolidated statements of comprehensive income. The following is a reconciliation of net income in accordance with GAAP to adjusted EBITDA for years ended December 31, 2019 and 2018:

	For the Years Ended December 31,	
	2019	2018
	(Amounts in thousands)	
GAAP net income	$21,411	$16,617
Non-GAAP EBITDA adjustments to net income:		
Investment income	(5,324)	(1,895)
Interest expense	9,292	6,709
Tax provision	4,740	4,819
Depreciation	7,317	5,213
Intangible amortization	13,551	10,565
EBITDA	50,987	42,028
Other non-GAAP adjustments:		
Acquisition and integration costs	13,008	2,928
Loss on extinguishment of debt	5,650	—
Inventory step-up charges	1,483	—
Adjusted EBITDA	$71,128	$44,956

Liquidity and Capital Resources

We have financed our operations primarily through revenues derived from product sales, the issuance of the 2016 Notes in May 2016 and our 2019 Notes (defined below) in July 2019 and the issuance of common stock in our July 2019, May 2019 and July 2017 public offerings. Our revenue for the foreseeable future will primarily be limited to our bioprocessing product revenue.

At December 31, 2019, we had cash and cash equivalents of $528.4 million compared to cash and cash equivalents of $193.8 million at December 31, 2018. As a result of our acquisition of C Technologies in May 2019, we are holding $9.0 million in restricted cash for compensation expense for future employment of C Technologies employees as of December 31, 2019. There were no restrictions on cash for December 31, 2018.

We acquired C Technologies on May 31, 2019 for $239.9 million in cash and shares of our common stock. The C Technologies Acquisition was funded through payment of approximately $195.0 million in cash and 779,221 unregistered shares of the Company's common stock totaling $53.9 million.

On May 3, 2019, the Company completed a public offering in which 3,144,531 shares of its common stock, including the underwriters' full exercise of an option to purchase up to an additional 410,156 shares, were sold to the public at a price of $64.00 per share. The total proceeds received by the Company from this offering, net of underwriting discounts and commissions and other estimated offering expenses payable by the Company, totaled approximately $189.6 million. Proceeds from this public offering were partially used to fund the C Technologies Acquisition on May 31, 2019.

On July 19, 2019, the Company completed a public offering in which 1,587,000 shares of its common stock, including the underwriters' full exercise of an option to purchase an additional 207,000 shares, were sold to the public at a price of $87.00 per share for $131.1 million in net proceeds to the Company, after deducting underwriting discounts and commissions and other estimated offering expenses payable by the Company (the "July Stock Offering").

On July 19, 2019, the Company issued $287.5 million aggregate principal amount of 0.375% Convertible Senior Notes due 2024 ("2019 Notes"), which includes the underwriters' exercise in full of an option to purchase an additional $37.5 million aggregate principal amount of 2019 Notes (the "Notes Offering" and, together with the July Stock Offering, the "Offerings"). The net proceeds of the Notes Offering, after deducting underwriting discounts and commissions and other offering expenses payable by the Company, were $278.5 million. See Note 11, *"Convertible Senior Notes,"* included in this report for more information on this transaction. The Company utilized a portion of the proceeds from the Offerings to settle its outstanding 2016 Notes during the third quarter of 2019. On July 16, 2019, the Company entered into separate privately negotiated agreements with certain holders of the 2016 Notes to exchange an aggregate of $92.0 million principal aggregate amount of the 2016 Notes for shares of the Company's common stock, together with cash, in private placement transactions (the "Note Exchanges"). On July 19, 2019 and July 22, 2019, the Company used approximately $92.3 million (including $0.3 million of accrued interest) and 1,850,155 shares of its common stock valued at $161.0 million to settle the Note Exchanges for total consideration of $253.3 million, of which $163.6 million was allocated to the equity component of the 2016 Notes. The Company allocated the consideration transferred to the liability and equity components using the same proportions as the initial carrying value of the 2016 Notes. The transaction resulted in a loss on extinguishment of debt of $4.6 million in the Company's consolidated statements of comprehensive income as of December 31, 2019.

During the fourth quarter of 2019, the closing price of the Company's common stock did not exceed 130% of the conversion price of the 2019 Notes for more than 20 trading days of the last 30 consecutive trading days of the quarter. Therefore, the 2019 Notes are not convertible at the option of the holders of the 2019 Notes during the first quarter of 2020 per the First Supplemental Indenture underlying the 2019 Notes. The 2019 Notes have a face value of $287.5 million and a carrying value of $232.8 million and are classified as long-term liabilities on the Company's consolidated balance sheet as of December 31, 2019.

In July 2017, we completed a public offering in which 2,807,017 shares of our common stock were sold to the public at a price of $42.75 per share. The underwriters were granted an option, which they exercised in full, to purchase an additional 421,052 shares of our common stock. The total proceeds from this offering, net of underwriting discounts, commissions and other offering expenses, totaled $129.3 million.

On August 1, 2017, we completed our acquisition of Spectrum for $112.8 million in cash (net of cash received) and 6,153,995 unregistered shares of the Company's common stock.

Cash flows

	For the Years Ended December 31,			FY19 vs FY18 $ Change	FY18 vs FY17 $ Change
	2019	2018	2017		
	(Amounts in thousands)				
Operating activities	$ 67,216	$ 32,770	$ 17,451	$ 34,446	$ 15,319
Investing activities	(205,308)	(14,037)	(98,696)	(191,271)	84,659
Financing activities	484,867	3,407	129,945	481,460	(126,538)
Effect of exchange rate changes on cash, cash equivalents and restricted cash	(3,190)	(2,077)	2,376	(1,113)	(4,453)
Net increase in cash, cash equivalents and restricted cash	$ 343,585	$ 20,063	$ 51,076	$ 323,522	$ (31,013)

Operating activities

For 2019, our operating activities provided cash of $67.2 million reflecting net income of $21.4 million and non-cash charges totaling $46.9 million primarily related to depreciation, amortization, non-cash interest expense, deferred taxes, loss on extinguishment of debt and stock-based compensation charges. An increase in accounts receivable consumed $7.7 million of cash and was primarily driven by the 39% year-to-date increase in

revenues and an increase in inventory consumed $9.3 million to support future revenue, due to the addition of C Technologies on May 31, 2019. These cash items provided by operating activities were offset by cash items used for operating activities that included an increase in accounts payable and accrued liabilities of $13.8 million due to the addition of C Technologies and a decrease in unbilled receivables of $2.1 million. The remaining cash used in operating activities resulted from unfavorable changes in various other working capital accounts.

For 2018, our operating activities provided cash of $32.8 million reflecting net income of $16.6 million and non-cash charges totaling $30.3 million primarily related to depreciation, amortization, non-cash interest expense, deferred tax expense and stock-based compensation charges. An increase in receivables consumed $8.7 million of cash and was primarily driven by the 37% year-to-date increase in revenues. An increase in inventory levels to accommodate future revenue growth consumed $4.0 million of cash, payment of accrued liabilities consumed $1.4 million of cash and an increase in other assets used $1.8 million. This utilization of cash is partially offset by $2.3 million of cash provided by an increase in accounts payable due to the timing of payments to vendors. The remaining cash flow used in operations resulted from net unfavorable changes in various other working capital accounts.

For 2017, our operating activities provided cash of $17.5 million, reflecting net income of $28.4 million offset by net non-cash charges totaling $3.4 million comprised mainly of depreciation, amortization, stock-based compensation charges and deferred tax benefits. Increases in accounts receivable consumed $6.9 million of cash, which is based on timing of revenues billed to and payments from customers. Decreases in accounts payable and accrued liabilities consumed $1.2 million of cash due to timing of payments to vendors.

Investing activities

Our investing activities consumed $205.3 million of cash during 2019. We used $182.2 million in cash (net of cash received) for the C Technologies Acquisition on May 31, 2019. Capital expenditures consumed $23.2 million as we continue to increase our manufacturing capacity worldwide. Of these expenditures, $4.7 million represented capitalized costs related to our internal-use software.

For 2018, our investing activities consumed $14.0 million of cash, including $12.8 million for capital expenditures. Of those expenditures, $2.1 million represented capitalized costs related to our internal-use software. In addition, a capitalized payment for developed technology of $1.3 million was paid to Navigo in 2018 to assist in expanding our proteins product offerings through a development agreement.

For 2017, our investing activities consumed $98.7 million of cash. We used $112.8 million in cash (net of cash received) for our acquisition of Spectrum. Fixed asset additions consumed $5.5 million, as we continued to increase our manufacturing capacity. Net redemptions of marketable securities provided $19.6 million of cash in 2017.

Financing activities

In 2019, cash provided by financing activities of $487.1 million included $320.7 million from the issuance of our common stock resulting from our public offerings completed in May and July 2019. In addition, in July 2019 the Company issued $287.5 million aggregate principal amount of the 2019 Notes for net proceeds of $278.5 million. Proceeds from stock option exercises during 2019 were $1.2 million. Offsetting these activities was $115.0 million of cash utilized by the Company in July 2019 to settle the 2016 Notes.

In 2018, our financing activities provided $3.4 million of cash. We received proceeds of $3.4 million from stock option exercises, partially offset by cash outlays of $11,000 related to the partial conversion of the 2016 Notes in the first quarter of 2018.

In July 2017, we received net proceeds of $129.3 million from the issuance of common stock. In May 2016, we received net proceeds of $111.1 million from the issuance of the 2016 Notes. Exercises of stock options provided

cash receipts of $2.4 million and $1.8 million in 2017 and 2016, respectively. Cash payments to Atoll and Refine in 2017 totaled $5.1 million, of which $1.7 million related to the fair value of these liabilities as of the respective acquisition dates and is included as part of financing activities. Cash payments to Refine and BioFlash in 2016 totaled $4.1 million, of which $0.8 million related to the fair value of these liabilities as of the respective acquisition dates and is included as part of financing activities. The remaining amounts are included as an offset to our cash provided by operating activities.

Off-Balance Sheet Arrangements

We do not have any special purpose entities or off-balance sheet financing arrangements.

Contractual Obligations

As of December 31, 2019, we had the following fixed obligations and commitments:

	Total	Less than one year	One to three years	Three to five years	Over five years
			(Amounts in thousands)		
Convertible senior notes	$287,500	$ —	$ —	$ —	$287,500
Operating lease obligations	33,469	5,175	10,139	6,939	11,216
Purchase obligations[1]	40,455	39,055	1,400	—	—
Total	$361,424	$44,230	$11,539	$6,939	$298,716

(1) Primarily represents purchase commitments with certain vendors and open purchase orders for the procurement of raw materials for manufacturing.

The table excludes a liability for uncertain tax positions totaling $3.4 million since we cannot currently make a reliable estimate of the period in which the liability will be payable, if ever. Please see Note 8, *"Income Taxes,"* to our consolidated financial statements included in this report for more information.

Capital Requirements

Our future capital requirements will depend on many factors, including the following:

- the expansion of our bioprocessing business;
- the ability to sustain sales and profits of our bioprocessing products;
- our ability to acquire additional bioprocessing products;
- the scope of and progress made in our research and development activities;
- the extent of any share repurchase activity; and
- the success of any proposed financing efforts.

Absent acquisitions of additional products, product candidates or intellectual property, we believe our current cash balances are adequate to meet our cash needs for at least the next 24 months. We expect operating expenses in the year ending December 31, 2020 to increase as we continue to expand our bioprocessing business. We expect to incur continued spending related to the development and expansion of our bioprocessing product lines and expansion of our commercial capabilities for the foreseeable future. Our future capital requirements may include, but are not limited to, purchases of property, plant and equipment, the acquisition of additional bioprocessing products and technologies to complement our existing manufacturing capabilities, and continued investment in our intellectual property portfolio.

We plan to continue to invest in our bioprocessing business and in key research and development activities associated with the development of new bioprocessing products. We actively evaluate various strategic

transactions on an ongoing basis, including licensing or acquiring complementary products, technologies or businesses that would complement our existing portfolio. We continue to seek to acquire such potential assets that may offer us the best opportunity to create value for our shareholders. In order to acquire such assets, we may need to seek additional financing to fund these investments. If our available cash balances and anticipated cash flow from operations are insufficient to satisfy our liquidity requirements, including because of any such acquisition-related financing needs or lower demand for our products, we may seek to sell common or preferred equity or convertible debt securities, enter into a credit facility or another form of third-party funding, or seek other debt funding. The sale of equity and convertible debt securities may result in dilution to our stockholders, and those securities may have rights senior to those of our common shares. If we raise additional funds through the issuance of preferred stock, convertible debt securities or other debt financing, these securities or other debt could contain covenants that would restrict our operations. Any other third-party funding arrangement could require us to relinquish valuable rights. We may require additional capital beyond our currently anticipated amounts. Additional capital may not be available on reasonable terms, if at all.

Net Operating Loss Carryforwards

At December 31, 2019, we had net operating loss carryforwards of $0.2 million remaining. We had business tax credits carryforwards of $2.1 million available to reduce future federal income taxes, if any. The business tax credits carryforwards will continue to expire at various dates through December 2039. Net operating loss carryforwards and available tax credits are subject to review and possible adjustment by the Internal Revenue Service, state and foreign jurisdictions and may be limited in the event of certain changes in the ownership interest of significant stockholders.

Foreign Earnings

As of December 31, 2019, the Company has accumulated undistributed earnings generated by our foreign subsidiaries of approximately $93.5 million. Because $58.0 million of such earnings have previously been subject to the one-time transition tax on foreign earnings required by the 2017 Tax Act, any additional taxes due with respect to such earnings or the excess of the amount for financial reporting over the tax basis of our foreign investments would generally be limited to foreign and state taxes. At December 31, 2019, we have not provided for taxes on outside basis differences of our foreign subsidiaries, as we have the ability and intent to indefinitely reinvest the undistributed earnings of our foreign subsidiaries, and there are no needs for such earnings in the United States that would contradict our plan to indefinitely reinvest.

Effects of Inflation

Our assets are primarily monetary, consisting of cash and cash equivalents. Because of their liquidity, these assets are not directly affected by inflation. Since we intend to retain and continue to use our equipment, furniture, fixtures and office equipment, computer hardware and software and leasehold improvements, we believe that the incremental inflation related to replacement costs of such items will not materially affect our operations. However, the rate of inflation affects our expenses, such as those for employee compensation and contract services, which could increase our level of expenses and the rate at which we use our resources.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

We are exposed to market risk in the ordinary course of our business. Market risk represents the risk of loss that may impact our financial position due to adverse changes in financial market prices and rates. Our market risk exposure is primarily a result of fluctuations in interest rates and foreign currency exchange rates.

Interest Rate Risk

We have historically held investments in commercial paper, U.S. Government and agency securities as well as corporate bonds and other debt securities. As a result, we have been exposed to potential loss from market risks

that may occur as a result of changes in interest rates, changes in credit quality of the issuer or otherwise. We do not have any such investments as of December 31, 2019. As a result, a hypothetical 100 basis point increase in interest rates would have no effect on our cash position as of December 31, 2019.

We generally place our marketable security investments in high quality credit instruments, as specified in our investment policy guidelines. We believe that the conservative nature of our investments mitigates our interest rate exposure, and our investment policy limits the amount of our credit exposure to any one issue, issuer (with the exception of U.S. agency obligations) and type of instrument. We do not expect any material loss from our marketable security investments and therefore believe that our potential interest rate exposure is limited.

Foreign Exchange Risk

The reporting currency of the Company is U.S. dollars, and the functional currency of each of our foreign subsidiaries is its respective local currency. Our foreign currency exposures include the Swedish krona, Euro, British pound, Chinese yuan, Japanese yen, Singapore dollar, South Korean won and Indian rupee; of these, the primary foreign currency exposures are the Swedish kronor, Euro and British pound. Exchange gains or losses resulting from the translation between the transactional currency and the functional currency are included in net income. Fluctuations in exchange rates may adversely affect our results of operations, financial position and cash flows. We currently do not seek to hedge this exposure to fluctuations in exchange rates.

Although a majority of our contracts are denominated in U.S. dollars, 29% and 28% of total revenues during 2019 and 2018, respectively, were denominated in foreign currencies while 17% and 22% of our costs and expenses during 2019 and 2018, respectively, were denominated in foreign currencies, primarily operating expenses associated with cost of revenue, sales and marketing and general and administrative. In addition, 16% and 24% of our consolidated tangible assets were subject to foreign currency exchange fluctuations as of each of December 31, 2019 and 2018, respectively, while 5% and 6% of our consolidated liabilities were exposed to foreign currency exchange fluctuations as of each of December 31, 2019 and 2018, respectively.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

Financial statements and supplementary data required by Item 8 are set forth at the pages indicated in Item 15(a) below and are incorporated herein by reference.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE.

None.

ITEM 9A. CONTROLS AND PROCEDURES

(a) Disclosure Controls and Procedures.

The Company's management, with the participation of our principal executive officer and principal financial officer, has evaluated the effectiveness of the Company's disclosure controls and procedures (as defined in Rules 13a-15(e) or 15d-15(e) under the Exchange Act and as required by paragraph (b) of Rules 13a-15 or 15d-15 under the Exchange Act) as of the end of the period covered by this report. Based on such evaluation, our principal executive officer and principal financial officer have concluded that, as of the end of such period, the Company's disclosure controls and procedures were effective at the reasonable assurance level.

(b) Report of Management on Internal Control Over Financial Reporting.

Management of the Company is responsible for establishing and maintaining adequate internal control over financial reporting. Internal control over financial reporting is defined in Rule 13a-15(f) and 15d-15(f) under the

Exchange Act as a process designed by, or under the supervision of, the Company's principal executive and principal financial officers and effected by the Company's Board of Directors, management and other personnel, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with U.S. generally accepted accounting principles and includes those policies and procedures that:

- pertain to the maintenance of records that in reasonable detail accurately and fairly reflect the transactions and dispositions of the assets of the Company;
- provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the Company are being made only in accordance with authorizations of management and directors of the Company; and
- provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of the Company's assets that could have a material effect on the financial statements.

Management assessed the effectiveness of the Company's internal control over financial reporting as of December 31, 2019. In making this assessment, management used the criteria established in *Internal Control – Integrated Framework*, issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (COSO).

We acquired C Technologies on May 31, 2019. The financial results of C Technologies are included in our audited consolidated financial statements as of December 31, 2019. The C Technologies business represented $261,848,000 of total assets as of December 31, 2019 and $16,410,000 of revenues for the year then ended. As this acquisition occurred in the second quarter of 2019, the scope of our assessment of our internal control over financial reporting does not include C Technologies. This exclusion is in accordance with the SEC's general guidance that an assessment of a recently acquired business may be omitted from our scope in the year of acquisition.

In connection with our initiative to integrate and enhance our global information technology systems and business processes, we initiated the phased implementation of a new enterprise resource planning ("ERP") system. The ERP system is being implemented in phases through 2020. The first phase was completed during the third quarter of 2019. As a result of this implementation, we modified certain existing internal controls over financial reporting as well as implemented new controls and procedures related to the new ERP system as of December 31, 2019.

Other than the foregoing, there have been no changes in our internal control over financial reporting identified in connection with the evaluation required by paragraph (d) of Securities Exchange Act Rule 13a-15 or Rule 15d-15 that occurred in the three months ended December 31, 2019 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

Subject to the foregoing, based on this assessment, our management concluded that, as of December 31, 2019, our internal control over financial reporting is effective based on those criteria. Ernst & Young LLP, the independent registered public accounting firm that audited our financial statements included in this Form 10-K, has issued an attestation report on our internal control over financial reporting as of December 31, 2019.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Projections of any evaluation of effectiveness to future periods are subject to the risks that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

(c) Attestation Report of the Independent Registered Public Accounting Firm.

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Stockholders and the Board of Directors of Repligen Corporation:

Opinion on Internal Control over Financial Reporting

We have audited Repligen Corporation's internal control over financial reporting as of December 31, 2019, based on criteria established in Internal Control – Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (the COSO criteria). In our opinion, Repligen Corporation (the Company) maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on the COSO criteria.

As indicated in the accompanying Management's Report Over Financial Reporting, management's assessment of and conclusion on the effectiveness of internal control over financial reporting did not include the internal controls of C Technologies, Inc., which is included in the 2019 consolidated financial statements of the Company and constituted $261,848,000 of total assets as of December 31, 2019 and $16,410,000 of revenues for the year then ended. Our audit of internal control over financial reporting of the Company also did not include an evaluation of the internal control over financial reporting of C Technologies, Inc.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated balance sheets of the Company as of December 31, 2019 and 2018, the related consolidated statements of operations and comprehensive income, stockholders' equity and cash flows for each of the three years in the period ended December 31, 2019, and the related notes and our report dated February 26, 2020 expressed an unqualified opinion thereon.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting included in the accompanying Report of Management on Internal Control Over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects.

Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control Over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance

with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ Ernst & Young LLP

Boston, Massachusetts
February 26, 2020

(d) Changes in Internal Control Over Financial Reporting

There have been no changes in our internal control over financial reporting identified in connection with the evaluation required by paragraph (d) of Securities Exchange Act Rule 13a-15 or Rule 15d-15 that occurred in the three months ended December 31, 2019 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

ITEM 9B. OTHER INFORMATION

None.

PART III

Pursuant to General Instructions G to Form 10-K, the information required for Part III, Items 10, 11, 12, 13 and 14, is incorporated herein by reference from the Company's proxy statement for the 2019 Annual Meeting of Stockholders.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

The following documents are filed as part of this Form 10-K:

(a) (1) *Financial Statements*:

The financial statements required by this item are submitted in a separate section beginning on page 52 of this Report, as follows:

(a) (2) *Financial Statement Schedules*:

None.

(a) (3) *Exhibits*:

The Exhibits which are filed as part of this Form 10-K or which are incorporated by reference are set forth in the Exhibit Index hereto.

EXHIBIT INDEX

Exhibit Number	Document Description
2.1	Agreement and Plan of Merger and Reorganization, dated June 22, 2017, by and among Repligen Corporation, Top Hat, Inc., Swing Time, LLC, Spectrum, Inc., and Roy T. Eddleman (filed as Exhibit 2.1 to Repligen Corporation's Current Report on Form 8-K filed on June 23, 2017 and incorporated herein by reference).
2.2#	Stock Purchase Agreement, dated April 25, 2019, by and among Repligen Corporation, C Technologies and Craig Harrison (filed as Exhibit 2.1 to Repligen Corporation's Current Report on Form 8-K filed on April 26, 2019 and incorporated herein by reference).
3.1	Restated Certificate of Incorporation dated June 30, 1992, as amended September 17, 1999 (filed as Exhibit 3.1 to Repligen Corporation's Quarterly Report on Form 10-Q for the quarter ended September 30, 1999 and incorporated herein by reference).
3.2	Certificate of Amendment to the Certificate of Incorporation of Repligen Corporation, effective as of May 16, 2014 (filed as Exhibit 3.1 to Repligen Corporation's Current Report on Form 8-K filed on May 19, 2014 and incorporated herein by reference).
3.3	Second Amended and Restated Bylaws (filed as Exhibit 3.1 to Repligen Corporation's Current Report on Form 8-K filed on May 23, 2017 and incorporated herein by reference).

Exhibit Number	Document Description
4.1	Specimen Stock Certificate (filed as Exhibit 4.1 to Repligen Corporation's Annual Report on Form 10-K for the year ended March 31, 2002 and incorporated herein by reference).
4.2	Base Indenture, dated as of July 19, 2019, by and between Repligen Corporation and Wilmington Trust, National Association (filed as Exhibit 4.1 to Repligen Corporation's Current Report on Form 8-K filed on July 22, 2019 and incorporated herein by reference).
4.3	First Supplemental Indenture, dated as of July 19, 2019, by and between Repligen Corporation and Wilmington Trust, National Association (filed as Exhibit 4.2 to Repligen Corporation's Current Report on Form 8-K filed on July 22, 2019 and incorporated herein by reference).
4.4	Form of 0.375% Convertible Senior Note due 2024 (included in Exhibit 4.2).
4.5+	Description of Certain Registrant's Securities.
10.1*	Repligen Executive Incentive Compensation Plan (filed as Exhibit 10.1 to Repligen Corporation's Current Report on form 8-K filed on December 14, 2005 and incorporated herein by reference).
10.2*	Second Amended and Restated 2001 Repligen Corporation Stock Plan (filed as Exhibit 10.1 to Repligen Corporation's Current Report on Form 8-K filed on September 18, 2008 and incorporated herein by reference).
10.3.1*	Amended and Restated 2001 Repligen Corporation Stock Option Plan, Form of Incentive Stock Option Agreement (filed as Exhibit 10.14 to Repligen Corporation's Annual Report on Form 10-K for the year ended March 31, 2005 and incorporated herein by reference).
10.3.2*	Amended and Restated 2001 Repligen Corporation Stock Plan, Form of Restricted Stock Agreement (filed as Exhibit 10.1 to Repligen Corporation's Current Report on Form 8-K filed on January 9, 2006 and incorporated herein by reference).
10.4+	Lease Between Repligen Corporation as Tenant and West Seyon LLC as Landlord, 35 Seyon Street, Waltham, MA (as amended to date).
10.5#	Strategic Supplier Alliance Agreement dated January 28, 2010 by and between Repligen Corporation and GE Healthcare Bio-Sciences AB) (as amended to date) (filed as Exhibit 10.1 to Repligen Corporation's Quarterly Report on Form 10-Q for the quarter ended March 31, 2016 and incorporated herein by reference).
10.6	Lease Between Repligen Sweden AB (as successor-in-interest to Novozymes Biopharma Sweden AB) as Tenant and i-parken i Lund AB as Landlord, St. Lars Vag 47, 220 09 Lund, Sweden (filed as Exhibit 10.18 to Repligen Corporation's Transition Report on Form 10-K for the year ended December 31, 2011 and incorporated herein by reference).
10.7*	Repligen Corporation Amended and Restated 2012 Stock Option and Incentive Plan (filed as Exhibit 99.1 to Repligen Corporation's Form S-8 filed on June 2, 2014 and incorporated herein by reference).
10.8*	Letter Agreement, dated as of June 10, 2014, by and between Repligen Corporation and Jon K. Snodgres (filed as Exhibit 10.1 to Repligen Corporation's Current Report on Form 8-K filed on July 15, 2014 and incorporated herein by reference).
10.9*	Repligen Corporation Amended and Restated Non-Employee Directors' Compensation Policy (filed as Exhibit 10.3 to Repligen Corporation's Quarterly Report on Form 10-Q for the quarter ended March 31, 2018 and incorporated herein by reference).
10.10	Form of Indemnification Agreement (filed as Exhibit 10.1 to Repligen Corporation's Current Report on Form 8-K filed on May 12, 2016 and incorporated herein by reference).
10.11	Lease Agreement, dated February 6, 2018, by and between Repligen Corporation and U.S. REIF 111 Locke Drive Massachusetts, LLC (filed as Exhibit 10.1 to Repligen Corporation's Current Report on Form 8-K filed on February 8, 2018 and incorporated herein by reference).

Exhibit Number	Document Description
10.12*	2018 Repligen Corporation Stock Option and Incentive Plan (filed as Exhibit 10.1 to Repligen Corporation's Quarterly Report on Form 10-Q for the quarter ended June 30, 2018 and incorporated herein by reference).
10.13*	Letter Agreement, dated as of September 3, 2016 by and between Repligen Corporation and Ralf Kuriyel (filed as Exhibit 10.17 Repligen Corporation's Annual Report on Form 10-K for the year ended December 31, 2018 and incorporated herein by reference).
10.14*	Repligen Corporation Named Executive Officer Severance and Change in Control Plan, effective as of June 13, 2019 (filed as Exhibit 10.1 to Repligen Corporation's Current Report on Form 8-K filed on June 19, 2019 and incorporated herein by reference).
10.15*	Second Amended and Restated Employment Agreement, dated as of June 15, 2019, by and between Repligen Corporation and Tony J. Hunt (filed as Exhibit 10.2 to Repligen Corporation's Current Report on Form 8-K filed on June 19, 2019 and incorporated herein by reference).
21.1+	Subsidiaries of the Registrant.
23.1+	Consent of Ernst & Young LLP, Independent Registered Accounting Firm.
24.1+	Power of Attorney (included on signature page).
31.1+	Rule 13a-14(a)/15d-14(a) Certification.
31.2+	Rule 13a-14(a)/15d-14(a) Certification.
32.1+	Certification Pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.
101.INS+	Inline XBRL Instance Document-the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document.
101.SCH+	Inline XBRL Taxonomy Extension Schema Document.
101.CAL+	Inline XBRL Taxonomy Extension Calculation Linkbase Document.
101.DEF+	Inline XBRL Taxonomy Extension Definition Linkbase Document.
101.LAB+	Inline XBRL Taxonomy Extension Label Linkbase Document.
101.PRE+	Inline XBRL Taxonomy Extension Presentation Linkbase Document.
104+	Cover Page Interactive Data File (formatted as Inline XBRL with applicable taxonomy extension information contained in Exhibits 101.*).

Confidential treatment obtained as to certain portions.
* Management contract or compensatory plan or arrangement.
+ Filed electronically herewith.

The exhibits listed above are not contained in the copy of the Form 10-K distributed to stockholders. Upon the request of any stockholder entitled to vote at the 2020 annual meeting, the Registrant will furnish that person without charge a copy of any exhibits listed above. Requests should be addressed to Repligen Corporation, 41 Seyon Street, Waltham, MA 02453.

ITEM 16. 10-K SUMMARY

We may voluntarily include a summary of information required by Form 10-K under this Item 16. We have elected not to include such summary information.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

REPLIGEN CORPORATION

Date: February 26, 2020

By: /s/ TONY J. HUNT
Tony J. Hunt
President and Chief Executive Officer

POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below hereby makes, constitutes and appoints Tony J. Hunt and Jon K. Snodgres with full power to act without the other, his true and lawful attorney-in-fact and agent, with full power of substitution and resubstitution, for him and in his name, place and stead, in any and all capacities to sign any or all amendments to this Form 10-K, and to file the same with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorney-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing requisite and necessary to be done in connection therewith, as fully to all intents and purposes as he might or could do in person, hereby ratifying and confirming all that said attorney-in-fact and agents of any of them, or any substitute or substitutes, lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

Signature	Title	Date
/s/ TONY J. HUNT **Tony J. Hunt**	President, Chief Executive Officer and Director (Principal executive officer)	February 26, 2020
/s/ JON K. SNODGRES **Jon K. Snodgres**	Chief Financial Officer (Principal financial and accounting officer)	February 26, 2020
/s/ KAREN DAWES **Karen Dawes**	Chairperson of the Board	February 26, 2020
/s/ NICOLAS M. BARTHELEMY **Nicolas M. Barthelemy**	Director	February 26, 2020
/s/ GLENN L. COOPER **Glenn L. Cooper, M.D.**	Director	February 26, 2020
/s/ JOHN G. COX **John G. Cox**	Director	February 26, 2020
/s/ GLENN P. MUIR **Glenn P. Muir**	Director	February 26, 2020
/s/ THOMAS F. RYAN, JR. **Thomas F. Ryan, Jr.**	Director	February 26, 2020

INDEX TO FINANCIAL STATEMENTS

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Stockholders and the Board of Directors of Repligen Corporation:

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Repligen Corporation (the Company) as of December 31, 2019 and 2018, and the related consolidated statements of operations and comprehensive income, stockholders' equity and cash flows for each of the three years in the period ended December 31, 2019, and the related notes (collectively referred to as the "consolidated financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019, in conformity with U.S. generally accepted accounting principles.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2019, based on criteria established in Internal Control-Integrated Framework issued by the Committee of the Sponsoring Organizations of the Treadway Commission (2013 framework) and our report dated February 26, 2020 expressed an unqualified opinion thereon.

Adoption of New Accounting Standard

As discussed in Note 2 to the consolidated financial statements, the Company changed its method for accounting for leases in 2019 due to the adoption of ASU No. 2016-02, Leases (Topic 842).

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the US federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or FRAUD. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures include examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matter

The critical audit matters communicated below are matters arising from the current period audit of the financial statements that were communicated or required to be communicated to the audit committee and that: (1) relate to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matters below, providing separate opinions on the critical audit matters or on the accounts or disclosures to which they relate.

Accounting for acquisitions

Description of the Matter

During 2019, the Company completed its acquisition of C Technologies, Inc. for net consideration of $239.9 million, as disclosed in Note 3 to the consolidated financial statements. The transaction was accounted for as a business combination.

Auditing the Company's accounting for its acquisition of C Technologies was complex due to the significant estimation uncertainty in the Company's determination of the fair value of identified intangible assets of $90.8 million, which principally consisted of customer relationships and developed technology. The significant estimation uncertainty was primarily due to the sensitivity of the respective fair values to underlying assumptions about the future performance of the acquired business. The Company used a discounted cash flow model to measure the customer relationship and developed technology intangible assets. The significant assumptions used to estimate the value of the intangible assets included discount rates and certain assumptions that form the basis of the forecasted results (e.g., revenue growth rates and operating profit margin). These significant assumptions are forward looking and could be affected by future economic and market conditions.

How We Addressed the Matter in Our Audit

We tested the Company's controls over its accounting for acquisitions. Our tests included controls over the process supporting the recognition and measurement of consideration transferred, customer relationship, and developed technology intangible assets. We also tested management's review of assumptions used in the valuation models.

To test the estimated fair value of the customer relationship and developed technology intangible assets, we performed audit procedures that included, among others, evaluating the Company's selection of the valuation methodology, evaluating the methods and significant assumptions used by the Company, and evaluating the completeness and accuracy of the underlying data supporting the significant assumptions and estimates. This includes comparing the significant assumptions to current industry, market and economic trends, to the assumptions used to value similar assets in other acquisitions, to the historical results of the acquired business and to other guidelines used by companies within the same industry. We involved our valuation professionals to assist in our evaluation of the methodology used by the Company and significant assumptions included in the fair value estimates.

Issuance of Convertible Senior Notes due 2024

Description of the Matter

As described in Note 11 to the consolidated financial statements, the Company issued $287.5 million aggregate principal amount of 0.375% Convertible Senior Notes due in 2024 ("2019 Notes"). The Company accounted for the 2019 Notes as separate liability and equity components. The equity component represents an embedded conversion feature valued at issuance of the 2019 Notes at $52.1 million.

Auditing the Company's accounting for the issuance of the 2019 Notes was complex due to the inherent estimation uncertainty in the Company's valuation of the liability and equity components of the 2019 Notes. Management used a discounted cash flow model to estimate the value of the liability component. The inherent estimation uncertainty was primarily attributed to sensitivity of the discounted cash flow model to changes in the estimated effective yield given the quantitative significance of the transaction. Valuation of the liability component impacted the debt discount recorded at issuance, which is being amortized using the effective interest rate over the term of the 2019 Notes.

How We Addressed the Matter in Our Audit

We obtained an understanding, evaluated the design and tested the operating effectiveness of controls over the Company's process to assess and value attributed to the liability and equity components of the 2019 Notes issuance.

To test the estimated fair value of the liability and equity components, we performed audit procedures that included, among others, evaluating the Company's selection of the valuation methodology, evaluating the methods and significant assumptions used by the Company's valuation professional, and evaluating the completeness and accuracy of the underlying data contained in the discounted cash flow model compared to terms contained in the 2019 Notes. These audit procedures included engaging our valuation professionals to assist in our evaluation of the methodology used by the Company and assumptions included in determination of the discount rate and discounted cash flow model. This included evaluating individual assumptions used by management and also developing an independent model. We assessed the sensitivity of the discounted cash flow model to changes in the discount rate, and resulting changes in value of the liability and equity components. We also assessed the Company's selection of the valuation methodology, evaluated the methods and significant assumptions used by the Company's valuation professional, and evaluated the completeness and accuracy of the underlying data supporting the significant assumptions and estimates.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 2002
Boston, Massachusetts
February 26, 2020

REPLIGEN CORPORATION
CONSOLIDATED BALANCE SHEETS
(Amounts in thousands, except share data)

	December 31, 2019	December 31, 2018
Assets		
Current assets:		
Cash and cash equivalents	$ 528,392	$193,822
Restricted cash	9,015	—
Accounts receivables, less reserve for doubtful accounts of $525 and $227 at December 31, 2019 and December 31, 2018, respectively	43,068	33,015
Royalties and other receivables	148	136
Unbilled receivables	456	2,602
Inventories, net	54,832	42,263
Prepaid expenses and other current assets	5,917	3,901
Total current assets	641,828	275,739
Property, plant and equipment, net	48,455	32,180
Intangible assets, net	212,552	135,438
Goodwill	468,413	326,735
Deferred tax assets	2,920	4,355
Operating lease right of use assets	25,707	—
Other assets	238	174
Total assets	$1,400,113	$774,621
Liabilities and Stockholders' Equity		
Current liabilities:		
Accounts payable	$ 11,425	$ 10,489
Operating lease liability	3,557	—
Accrued liabilities	33,331	15,865
Convertible senior notes, current portion	—	103,488
Total current liabilities	48,313	129,842
Convertible senior notes, net	232,767	—
Deferred tax liabilities	29,944	25,086
Operating lease liability, long-term	26,995	—
Other liabilities, long-term	2,326	4,125
Total liabilities	340,345	159,053
Commitments and contingencies (Note 10)		
Stockholders' equity:		
Preferred stock, $0.01 par value, 5,000,000 shares authorized, no shares issued or outstanding	—	—
Common stock, $0.01 par value; 80,000,000 shares authorized; 52,078,258 shares at December 31, 2019 and 43,917,378 shares at December 31, 2018 issued and outstanding	521	439
Additional paid-in capital	1,068,431	642,590
Accumulated other comprehensive loss	(15,027)	(11,893)
Accumulated earnings (deficit)	5,843	(15,568)
Total stockholders' equity	1,059,768	615,568
Total liabilities and stockholders' equity	$1,400,113	$774,621

The accompanying notes are an integral part of these consolidated financial statements.

REPLIGEN CORPORATION
CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME
(Amounts in thousands, except per share data)

	For the Years Ended December 31,		
	2019	**2018**	**2017**
Revenue:			
Products	$270,097	$193,891	$141,089
Royalty and other revenue	148	141	147
Total revenue	270,245	194,032	141,236
Costs and operating expenses:			
Cost of product revenue	119,099	86,531	67,050
Research and development	19,450	15,821	8,672
Selling, general and administrative	95,613	65,692	51,509
Total costs and operating expenses	234,162	168,044	127,231
Income from operations	36,083	25,988	14,005
Other (expenses) income:			
Investment income	5,324	1,895	371
Loss on extinguishment of debt	(5,650)	—	—
Interest expense	(9,292)	(6,709)	(6,441)
Other (expenses) income	(314)	262	(687)
Other expenses, net	(9,932)	(4,552)	(6,757)
Income before income taxes	26,151	21,436	7,248
Income tax provision (benefit)	4,740	4,819	(21,105)
Net income	$ 21,411	$ 16,617	$ 28,353
Earnings per share:			
Basic	$ 0.44	$ 0.38	$ 0.74
Diluted	$ 0.44	$ 0.37	$ 0.72
Weighted average common shares outstanding:			
Basic	48,343	43,767	38,234
Diluted	49,206	45,471	39,150
Net income	$ 21,411	$ 16,617	$ 28,353
Other comprehensive income (loss):			
Foreign currency translation adjustment	(3,134)	(5,530)	7,381
Unrealized gain on marketable securities	—	—	5
Comprehensive income	$ 18,277	$ 11,087	$ 35,739

The accompanying notes are an integral part of these consolidated financial statements.

REPLIGEN CORPORATION
CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(Amounts in thousands, except share data)

	Common Stock					
	Number of Shares(#)	Par Value	Additional Paid-In Capital	Accumulated Other Comprehensive Income (Loss)	Accumulated Earnings/(Deficit)	Total Stockholders' Equity
Balance at December 31, 2016	33,844,074	$338	$ 242,036	$(13,749)	$(59,861)	$ 168,764
Net income	—	—	—	—	28,353	28,353
Exercise of stock options and releases of restricted stock	330,185	3	2,348	—	—	2,351
Unrealized gain on investments	—	—	—	5	—	5
Issuance of common stock pursuant to the acquisition of Spectrum Lifesciences, LLC	6,153,995	62	247,513	—	—	247,575
Payment of contingent consideration in stock	30,756	1	1,062	—	—	1,063
Proceeds from issuance of common stock, net of issuance costs of $8,691	3,228,069	32	129,277	—	—	129,309
Stock-based compensation expense	—	—	6,747	—	—	6,747
Translation adjustment	—	—	—	7,381	—	7,381
Balance at December 31, 2017	43,587,079	436	628,983	(6,363)	(31,508)	591,548
Net income	—	—	—	—	16,617	16,617
Issuance of common stock for debt conversion	2	0	0	—	—	0
Exercise of stock options and releases of restricted stock	330,297	3	3,415	—	—	3,418
Stock-based compensation expense	—	—	10,192	—	—	10,192
Cumulative effect of accounting changes	—	—	—	—	(677)	(677)
Translation adjustment	—	—	—	(5,530)	—	(5,530)
Balance at December 31, 2018	43,917,378	439	642,590	(11,893)	(15,568)	615,568
Net income	—	—	—	—	21,411	21,411
Issuance of common stock for debt conversion	2,316,229	23	198,734	—	—	198,757
Reduction of equity component from debt conversion, net of tax	—	—	(200,079)	—	—	(200,079)
Exercise of stock options and releases of restricted stock	339,329	3	1,164	—	—	1,167
Issuance of common stock pursuant to the acquisition of C Technologies, Inc.	779,221	8	53,930	—	—	53,938
Tax withholding on vesting of restricted stock	(5,430)	(0)	(490)	—	—	(490)
Equity component of 0.375% senior convertible notes, net of tax	—	—	39,070	—	—	39,070
Proceeds from issuance of common stock, net of issuance costs of $18,607	4,731,531	48	320,665	—	—	320,713
Stock-based compensation expense	—	—	12,847	—	—	12,847
Translation adjustment	—	—	—	(3,134)	—	(3,134)
Balance at December 31, 2019	52,078,258	$521	$1,068,431	$(15,027)	$ 5,843	$1,059,768

The accompanying notes are an integral part of these consolidated financial statements.

REPLIGEN CORPORATION
CONSOLIDATED STATEMENTS OF CASH FLOWS
(Amounts in thousands)

	For the Years Ended December 31,		
	2019	**2018**	**2017**
Cash flows from operating activities:			
Net income	$ 21,411	$ 16,617	$ 28,353
Adjustments to reconcile net income to net cash provided by operating activities:			
Depreciation and amortization	20,868	15,778	10,507
Non-cash interest expense	7,536	4,248	3,977
Stock-based compensation expense	12,847	10,192	6,747
Deferred tax expense	(624)	71	(24,679)
Loss on extinguishment of debt	5,650	—	—
Other	663	(3)	64
Changes in operating assets and liabilities, excluding impact of acquisitions:			
Accounts receivable	(7,726)	(6,101)	(6,888)
Royalties and other receivables	(104)	7	644
Unbilled receivables	2,146	(2,602)	—
Inventories	(9,314)	(4,042)	605
Prepaid expenses and other assets	(661)	(1,769)	(1,304)
Operating lease right of use assets	(4,662)	—	—
Accounts payable	662	2,266	807
Accrued expenses	13,096	(1,398)	(1,993)
Operating lease liability	5,447	—	—
Long-term liabilities	(19)	(494)	611
Total cash provided by operating activities	67,216	32,770	17,451
Cash flows from investing activities:			
Purchases of marketable securities	—	—	(47)
Redemption of marketable securities	—	—	19,600
Additions to capitalized software costs	(4,650)	(2,147)	—
Developed technology intangible asset payment	—	(1,255)	—
Acquisition of Spectrum Lifesciences, Inc., net of cash acquired	—	—	(112,795)
Acquisition of C Technologies, Inc. net of cash acquired	(182,154)	—	—
Purchases of property, plant and equipment	(18,504)	(10,635)	(5,454)
Total cash used in investing activities	(205,308)	(14,037)	(98,696)
Cash flows from financing activities:			
Proceeds from issuance of senior convertible notes, net of issuance costs	278,466	—	—
Proceeds from issuance of common stock, net of issuance costs	320,713	—	129,309
Exercise of stock options	1,167	3,418	2,351
Repayment of senior convertible notes	(114,989)	(11)	—
Payment of tax withholding obligation on vesting of restricted stock	(490)	—	(1,715)
Total cash provided by financing activities	484,867	3,407	129,945
Effect of exchange rate changes on cash, cash equivalents and restricted cash	(3,190)	(2,077)	2,376
Net increase in cash, cash equivalents and restricted cash	343,585	20,063	51,076
Cash, cash equivalents and restricted cash, beginning of period	193,822	173,759	122,683
Cash, cash equivalents and restricted cash, end of period	$ 537,407	$193,822	$ 173,759
Supplemental disclosure of cash flow information:			
Income taxes paid	$ 6,505	$ 4,046	$ 4,021
Interest paid	$ 1,484	$ 2,444	$ 2,444
Supplemental disclosure of non-cash investing and financing activities:			
Assets acquired under operating leases	8,663	—	—
Fair value of 2,316,229 shares of common stock issued for conversion of convertible notes	$ 198,757	$ —	$ —
Fair value of common stock issued for acquisition of C Technologies, Inc.	$ 53,938	$ —	$ —
Non-cash effect of adoption of ASU 2016-16	$ —	$ 5,609	$ —
Property, plant and equipment related to lease incentives	$ —	$ 2,270	$ —
Fair value of common stock issued for acquisition of Spectrum, Inc.	$ —	$ —	$ 247,575
Payment of contingent consideration in common stock	$ —	$ —	$ 1,063
Business Acquisitions:			
Fair value of tangible assets acquired	$ 30,756	$ —	$ 19,709
Fair value of accounts receivable	3,044	—	5,075
Fair value of other assets	3,929	—	1,718
Deferred tax assets, net	895	—	—
Liabilities assumed	(35,383)	—	(7,698)
Fair value of stock issued	(53,938)	—	(247,575)
Cost in excess of fair value of assets acquired (Goodwill)	142,021	—	265,519
Acquired identifiable intangible assets	90,830	—	120,080
Deferred tax liabilities, net	—	—	(43,608)
	182,154	—	113,220
Less working capital adjustment	—	—	(425)
Net cash paid for business acquisitions	$ 182,154	$ —	$ 112,795

The accompanying notes are an integral part of these consolidated financial statements.

REPLIGEN CORPORATION
NOTES TO CONSOLIDATED FINANCIAL STATEMENTS

1. Organization and Nature of Business

Repligen Corporation (NASDAQ:RGEN) is a global life sciences company that develops and commercializes highly innovative bioprocessing technologies and systems that increase efficiencies and flexibility in the process of manufacturing biological drugs. The Company's franchises include Chromatography (OPUS® Columns, chromatography resins, ELISA kits), Filtration (XCell ATF™ systems, TangenX™ SIUS™ flat sheet cassettes, Spectrum® Hollow Fibers, KrosFlo® Systems and ProConnex® single-use flow path assemblies), Process Analytics (SoloVPE® and FlowVPE®), and Proteins (Protein A affinity ligands and cell culture growth factors). The Company's bioprocessing products are sold to major life sciences companies, biopharmaceutical development companies and contract manufacturing organizations worldwide. The Company operates under one reportable segment. The Company's chief operating decision maker ("CODM") reviews financial information presented on a consolidated basis for purposes of allocating resources and evaluating financial performance. See Note 2, *"Summary of Significant Accounting Policies – Segment Reporting,"* for more information on the Company's segment.

Repligen's corporate headquarters is in Waltham, Massachusetts (USA) and its manufacturing facilities are located in Waltham, Massachusetts; Marlborough, Massachusetts, Rancho Dominguez, California; Irving, Texas; Bridgewater, New Jersey; Lund, Sweden; and Weingarten, Germany.

The Company is subject to a number of risks typically associated with companies in the biotechnology industry. These risks principally include the Company's dependence on key customers, development by the Company or its competitors of new technological innovations, dependence on key personnel, protection of proprietary technology, compliance with the FDA and other governmental regulations and approval requirements, as well as the ability to grow the Company's business and obtain adequate funding to finance this growth.

2. Summary of Significant Accounting Policies

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States ("GAAP") requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting periods.

Significant estimates and assumptions by management affect the Company's revenue recognition for multiple element arrangements, allowance for doubtful accounts, the net realizable value of inventory, valuations and purchase price allocations related to business combinations, expected future cash flows including growth rates, discount rates, terminal values and other assumptions and estimates used to evaluate the recoverability of long-lived assets, estimated fair values of intangible assets and goodwill, amortization methods and periods, warranty reserves, certain accrued expenses, stock-based compensation, tax reserves and recoverability of the Company's net deferred tax assets and related valuation allowance.

Although the Company regularly assesses these estimates, actual results could differ materially from these estimates. Changes in estimates are recorded in the period in which they become known. The Company bases its estimates on historical experience and various other assumptions that it believes to be reasonable under the circumstances.

Basis of Presentation

The consolidated financial statements include the accounts of the Company and its wholly-owned subsidiaries, Repligen Sweden AB, Repligen GmbH, Spectrum® LifeSciences LLC and its subsidiaries ("Spectrum," acquired on August 1, 2017), C Technologies, Inc. ("C Technologies," acquired on May 31, 2019), and Repligen

Singapore Pte. Ltd. All significant intercompany accounts and transactions have been eliminated in consolidation. Certain prior year balances have changed to reflect current year presentation.

Foreign Currency

The Company translates the assets and liabilities of its foreign subsidiary at rates in effect at the end of the reporting period. Revenues and expenses are translated at average rates in effect during the reporting period. Translation adjustments, including adjustments related to the Company's intercompany loan with Repligen Sweden AB and Repligen Sweden AB's intercompany loan with Repligen GmbH, are remeasured at each period end and included in accumulated other comprehensive loss.

Revenue Recognition

We generate revenue from the sale of bioprocessing products, equipment devices, and related consumables used with these equipment devices to customers in the life science and biopharmaceutical industries. Under Accounting Standard Codification No. ("ASC") 606, "*Revenue from Contracts with Customers,"* revenue is recognized when, or as, obligations under the terms of a contract are satisfied, which occurs when control of the promised products or services is transferred to customers. Revenue is measured as the amount of consideration the Company expects to receive in exchange for transferring products or services to a customer ("transaction price"). To the extent the transaction price includes variable consideration, the Company estimates the amount of variable consideration that should be included in the transaction price utilizing the expected value method or the most likely amount method, depending on the facts and circumstances relative to the contract. Variable consideration is included in the transaction price if, in the Company's judgment, it is probable that a significant future reversal of cumulative revenue under the contract will not occur. Estimates of variable consideration and determination of whether to include estimated amounts in the transaction price are based largely on an assessment of the Company's anticipated performance and all information (historical, current and forecasted) that is reasonably available. Sales, value add, and other taxes collected on behalf of third parties are excluded from revenue.

When determining the transaction price of a contract, an adjustment is made if payment from a customer occurs either significantly before or significantly after performance, resulting in a significant financing component. Applying the practical expedient in paragraph 606-10-32-18, the Company does not assess whether a significant financing component exists if the period between when the Company performs its obligations under the contract and when the customer pays is one year or less. None of the Company's contracts contained a significant financing component as of December 31, 2019.

Contracts with customers may contain multiple performance obligations. For such arrangements, the transaction price is allocated to each performance obligation based on the estimated relative standalone selling prices of the promised products or services underlying each performance obligation. The Company determines standalone selling prices based on the price at which the performance obligation is sold separately. If the standalone selling price is not observable through past transactions, the Company estimates the standalone selling price taking into account available information such as market conditions and internally approved pricing guidelines related to the performance obligations.

The Company recognizes product revenue under the terms of each customer agreement upon transfer of control to the customer, which occurs at a point in time.

Shipping and handling fees are recorded as a component of product revenue, with the associated costs recorded as a component of cost of product revenue.

Risks and Uncertainties

The Company evaluates its operations periodically to determine if any risks and uncertainties exist that could impact its operations in the near term. The Company does not believe that there are any significant risks which

have not already been disclosed in the consolidated financial statements. A loss of certain suppliers could temporarily disrupt operations, although alternate sources of supply exist for these items. The Company has mitigated these risks by working closely with key suppliers, identifying alternate sources and developing contingency plans.

Cash, Cash Equivalents and Restricted Cash

Cash and cash equivalents include cash on hand and on deposit. Highly liquid investments in money market mutual funds with an original maturity of three months or less are classified as cash equivalents. All cash equivalents are carried at cost, which approximates fair value. Restricted cash represents cash that is restricted as to withdrawal or usage. In connection with the Company's acquisition of C Technologies on May 31, 2019, cash is being held and is due to employees based on their continued employment with the Company one year after the date of the close of the acquisition. As of December 31, 2019, $9.0 million, which represents this amount due to employees, is being carried as restricted cash on the Company's consolidated balance sheet.

The Company adopted Accounting Standard Update No. ("ASU") 2016-18, *"Statement of Cash Flows (Topic 230): Restricted Cash,"* on January 1, 2018, which changed the presentation of the Company's consolidated statements of cash flows and related disclosures for all periods presented. Accordingly, the following is a summary of the Company's cash, cash equivalents, and restricted cash total as presented in the Company's consolidated statements of cash flows for the years ended December 31, 2019, 2018 and 2017:

	For the Years Ended December 31,		
	2019	2018	2017
	(Amounts in thousands)		
Cash and cash equivalents	$528,392	$193,822	$173,759
Restricted cash	9,015	—	—
Total cash, cash equivalents, and restricted cash	$537,407	$193,822	$173,759

There were no realized gains or losses on investments for the years ended December 31, 2019, 2018 and 2017.

Fair Value Measurement

In determining the fair value of its assets and liabilities, the Company uses various valuation approaches. The Company employs a hierarchy for inputs used in measuring fair value that maximizes the use of observable inputs and minimizes the use of unobservable inputs by requiring that observable inputs be used when available. Observable inputs are inputs that market participants would use in pricing the asset or liability based on market data obtained from sources independent of the Company. Unobservable inputs are inputs that reflect the Company's assumptions about the inputs that market participants would use in pricing the asset or liability and are developed based on the best information available in the circumstances. The fair value hierarchy is broken down into three levels based on the source of inputs as follows:

Level 1 – Valuations based on unadjusted quoted prices in active markets for identical assets or liabilities that the Company has the ability to access.

Level 2 – Valuations based on quoted prices for similar assets or liabilities in active markets, quoted prices for identical or similar assets or liabilities in markets that are not active and models for which all significant inputs are observable, either directly or indirectly.

Level 3 – Valuations based on inputs that are unobservable and significant to the overall fair value measurement.

The availability of observable inputs can vary among the various types of financial assets and liabilities. To the extent that the valuation is based on models or inputs that are less observable or unobservable in the market, the

determination of fair value requires more judgment. In certain cases, the inputs used to measure fair value may fall into different levels of the fair value hierarchy. In such cases, for financial statement disclosure purposes, the level in the fair value hierarchy within which the fair value measurement is categorized is based on the lowest level input that is significant to the overall fair value measurement.

As of December 31, 2019 and 2018, cash and cash equivalents on the Company's consolidated balance sheets included $415.6 million and $126.6 million, respectively, in money market accounts. These funds are valued on a recurring basis using Level 1 inputs.

In July 2019, the Company issued $287.5 million aggregate principal amount of the Company's 0.375% Convertible Senior Notes due July 15, 2024 (the "2019 Notes"). Interest is payable semi-annually in arrears on January 15 and July 15 of each year. The 2019 Notes will mature on July 15, 2024 unless earlier converted or repurchased in accordance with their terms. As of December 31, 2019, the carrying value of the 2019 Notes was $232.8 million, net of unamortized discount, and the fair value of the 2019 Notes was $296.1 million. The fair value of the 2019 Notes is a Level 1 valuation and was determined based on the most recent trade activity of the 2019 Notes as of December 31, 2019. The 2019 Notes are discussed in more detail in Note 11, *"Convertible Senior Notes,"* to these consolidated financial statements.

There were no remeasurements to fair value during the year ended December 31, 2019 of financial assets and liabilities that are not measured at fair value on a recurring basis.

Inventories

Inventories relate to the Company's bioprocessing business. The Company values inventory at cost or, if lower, net realizable value, using the first-in, first-out method. The Company reviews its inventories at least quarterly and records a provision for excess and obsolete inventory based on its estimates of expected sales volume, production capacity and expiration dates of raw materials, work-in-process and finished products. Expected sales volumes are determined based on supply forecasts provided by key customers for the next 3 to 12 months. The Company writes down inventory that has become obsolete, inventory that has a cost basis in excess of its expected net realizable value, and inventory in excess of expected requirements to cost of product revenue. Manufacturing of bioprocessing finished goods is done to order and tested for quality specifications prior to shipment.

A change in the estimated timing or amount of demand for the Company's products could result in additional provisions for excess inventory quantities on hand. Any significant unanticipated changes in demand or unexpected quality failures could have a significant impact on the value of inventory and reported operating results. During all periods presented in the accompanying financial statements, there have been no material adjustments related to a revised estimate of inventory valuations.

Work-in-process and finished products inventories consist of material, labor, outside processing costs and manufacturing overhead.

Lease Accounting

The Company adopted ASU 2016-02, *"Leases (Topic 842)*" ("ASC 842") as of January 1, 2019. Under ASC 842, the Company determines whether the arrangement contains a lease at the inception of an arrangement. If a lease is identified in an arrangement, the Company recognizes a right-of-use asset and liability on its consolidated balance sheet and determines whether the lease should be classified as a finance or operating lease. The Company does not recognize assets or liabilities for leases with lease terms of less than 12 months.

A lease qualifies as a finance lease if any of the following criteria are met at the inception of the lease: (i) there is a transfer of ownership of the leased asset to the Company by the end of the lease term, (ii) the Company holds

an option to purchase the leased asset that it is reasonably certain to exercise, (iii) the lease term is for a major part of the remaining economic life of the leased asset, (iv) the present value of the sum of lease payments equals or exceeds substantially all of the fair value of the leased asset, or (v) the nature of the leased asset is specialized to the point that it is expected to provide the lessor no alternative use at the end of the lease term. All other leases are recorded as operating leases.

Finance and operating lease assets and liabilities are recognized at the lease commencement date based on the present value of the lease payments over the lease term using the discount rate implicit in the lease. If the rate implicit is not readily determinable, the Company utilizes its incremental borrowing rate at the lease commencement date. Operating lease assets are further adjusted for prepaid or accrued lease payments. Operating lease payments are expensed using the straight-line method as an operating expense over the lease term. Finance lease assets are amortized to depreciation expense using the straight-line method over the shorter of the useful life of the related asset or the lease term. Finance lease payments are bifurcated into (i) a portion that is recorded as imputed interest expense and (ii) a portion that reduces the finance liability associated with the lease.

The Company does not separate lease and non-lease components when determining which lease payments to include in the calculation of its lease assets and liabilities. Variable lease payments are expensed as incurred. If a lease includes an option to extend or terminate the lease, the Company reflects the option in the lease term if it is reasonably certain it will exercise the option.

Finance leases are recorded in property, plant and equipment, net, other current liabilities and long-term finance lease liabilities and operating leases are recorded in operating lease right of use assets, operating lease liability and operating lease liability, long-term on the Company's consolidated balance sheet.

Certain of the Company's operating leases where the Company is the lessee provide for minimum annual payments that increase over the life of the lease. Some of these leases include obligations to pay for other services, such as operations and maintenance. For leases of property, the Company accounts for these other services as a component of the lease. The aggregate minimum annual payments are expensed on the straight-lined basis beginning when the Company takes possession of the property and extending over the term of the related lease, including renewal options when the exercise of the option is reasonably assured as an economic penalty may be incurred if the option is not exercised. The Company also accounts in its straight-line computation for the effect of any "rental holidays."

Operating lease assets represent the Company's right to use an underlying asset for the lease term and lease liabilities represent the Company's obligation to make lease payments arising from the lease. Operating lease assets and liabilities are recognized at the lease commencement date based on the estimated present value of the fixed lease payments, reduced by landlord incentives using a discount rate based on similarly secured borrowings available to the Company. Most of the leases do not provide implicit interest rates and therefore the Company determines the discount rate based on its incremental borrowing rate. The incremental borrowing rate for the Company's leases is determined based on lease term and currency in which the lease payments are made.

Accrued Liabilities

The Company estimates accrued liabilities by identifying services performed on the Company's behalf, estimating the level of service performed and determining the associated cost incurred for such service as of each balance sheet date. For example, the Company would accrue for professional and consulting fees incurred with law firms, audit and accounting service providers and other third-party consultants. These expenses are determined by either requesting those service providers to estimate unbilled services at each reporting date for services incurred or tracking costs incurred by service providers under fixed fee arrangements.

The Company has processes in place to estimate the appropriate amounts to record for accrued liabilities, which principally involve the applicable personnel reviewing the services provided. In the event that the Company does

not identify certain costs that have begun to be incurred or the Company under or over-estimates the level of services performed or the costs of such services, the reported expenses for that period may be too low or too high. The date on which certain services commence, the level of services performed on or before a given date, and the cost of such services often require the exercise of judgment. The Company makes these judgments based upon the facts and circumstances known at the date of the financial statements.

Income Taxes

Deferred taxes are determined based on the difference between the financial statement and tax basis of assets and liabilities using enacted tax rates in effect in the years in which the differences are expected to reverse. Valuation allowances are provided, if, based upon the weight of available evidence, it is more likely than not that some or all of the deferred tax assets will not be realized. The Company accounts for uncertain tax positions using a "more-likely-than-not" threshold for recognizing and resolving uncertain tax positions. The evaluation of uncertain tax positions is based on factors including, but not limited to, changes in tax law, the measurement of tax positions taken or expected to be taken in tax returns, the effective settlement of matters subject to audit, new audit activity and changes in facts or circumstances related to a tax position. The Company evaluates this tax position on a quarterly basis. The Company also accrues for potential interest and penalties related to unrecognized tax benefits in income tax expense.

Property, Plant & Equipment

Property, plant & equipment is recorded at cost less allowances for depreciation. Depreciation is calculated using the straight-line method over the estimated useful life of the asset as follows:

Classification	Estimated Useful Life
Buildings	Thirty years
Leasehold improvements	Shorter of the term of the lease or estimated useful life
Equipment	Three to twelve years
Furniture, fixtures and office equipment	Three to eight years
Computer hardware and software	Three to five years or estimated useful life

Upon disposal of Property, plant & equipment, the cost of the asset and the accumulated depreciation are removed from the accounts and the resulting gain or loss is reflected in earnings. Fully depreciated assets are not removed from the accounts until they are physically disposed of.

Earnings Per Share

Basic earnings per share is computed by dividing net income available to common shareholders by the weighted average number of common shares outstanding during the period. Diluted earnings per share is computed by dividing net income available to common shareholders by the weighted-average number of common shares and dilutive common share equivalents then outstanding. Potential common share equivalents consist of restricted stock awards and the incremental common shares issuable upon the exercise of stock options and warrants. Under the treasury stock method, unexercised "in-the-money" stock options are assumed to be exercised at the beginning of the period or at issuance, if later. The assumed proceeds are then used to purchase common shares at the average market price during the period. In periods when the Company has a net loss, stock awards are excluded from the calculation of earnings per share as their inclusion would have an antidilutive effect.

A reconciliation of basic and diluted share amounts is as follows:

	For the Years Ended December 31,		
	2019	2018	2017
	(Amounts in thousands, except per share data)		
Net income	$21,411	$16,617	$28,353
Weighted average shares used in computing net income per share - basic	48,343	43,767	38,234
Effect of dilutive shares:			
Stock options and restricted stock awards	864	581	441
Convertible senior notes	—	1,123	475
Dilutive potential common shares	864	1,704	916
Weighted average shares used in computing net income per share - diluted	49,206	45,471	39,150
Earnings per share:			
Basic	$ 0.44	$ 0.38	$ 0.74
Diluted	$ 0.44	$ 0.37	$ 0.72

At December 31, 2019, there were outstanding options to purchase 957,559 shares of the Company's common stock at a weighted average exercise price of $30.81 per share and 734,984 shares of common stock issuable upon the vesting of stock units which include restricted stock units and performance stock units. For the year ended December 31, 2019, 104,316 shares of the Company's common stock were excluded from the calculation of diluted earnings per share because the exercise prices of the stock options were greater than or equal to the average price of the common shares and were therefore, anti-dilutive.

At December 31, 2018, there were outstanding options to purchase 998,226 shares of the Company's common stock at a weighted average exercise price of $27.54 per share and 705,413 shares of common stock issuable upon the vesting of stock units. For the year ended December 31, 2018, 479,854 shares of the Company's common stock were excluded from the calculation of diluted earnings per share because the exercise prices of the stock options were greater than or equal to the average price of the common shares and were therefore, anti-dilutive.

At December 31, 2017, there were outstanding options to purchase 734,940 shares of the Company's common stock at a weighted average exercise price of $20.80 per share and 505,235 shares of common stock issuable upon the vesting of stock units. For the year ended December 31, 2017, 317,923 shares of the Company's common stock were excluded from the calculation of diluted earnings per share because the exercise prices of the stock options were greater than or equal to the average price of the common shares and were therefore, anti-dilutive.

As provided by the terms of the indenture underlying the senior convertible notes, the Company has a choice to settle the conversion obligation for the Convertible Notes in cash, shares or any combination of the two. The Company currently intends to settle the par value of the Convertible Notes in cash and any excess conversion premium in shares. The Company applies the provisions of ASC 260, *"Earnings Per Share",* Subsection 10-45-44, to determine the diluted weighted average shares outstanding as it relates to the conversion spread on its convertible notes. Accordingly, the par value of the Convertible Notes is not included in the calculation of diluted income per share, but the dilutive effect of the conversion premium is considered in the calculation of diluted net income per share using the treasury stock method. The dilutive impact of the Convertible Notes is based on the difference between the Company's current period average stock price and the conversion price of the convertible notes, provided there is a premium. Pursuant to this accounting standard, there is no dilution from the accreted principal of the Convertible Notes. The dilutive effect of the conversion premium included in the calculation of diluted earnings per share was 0 shares, 1,123,139 shares and 474,923 shares for the years ended December 31, 2019, 2018 and 2017, respectively.

Segment Reporting

The Company views its operations, makes decisions regarding how to allocate resources and manages its business as one reportable segment and one reporting unit. As a result, the financial information disclosed herein represents all of the material financial information related to the Company.

The following table represents product revenues by product line:

	For the Years Ended December 31,		
	2019[1]	2018	2017[2]
	(Amounts in thousands)		
Chromatography products	$ 64,635	$ 45,326	$ 36,309
Filtration products	119,534	90,586	49,050
Process analytics products	16,405	—	—
Proteins products	65,124	54,375	53,969
Other	4,399	3,604	1,761
Total product revenue	$270,097	$193,891	$141,089

(1) 2019 revenue for process analytics products includes revenue related to C Technologies from May 31, 2019 through December 31, 2019.

(2) 2017 revenue for filtration, chromatography and other products includes revenue related to Spectrum from August 1, 2017 through December 31, 2017.

Revenue from chromatography products includes the OPUS chromatography PPCs, chromatography resins and ELISA test kits. Revenue from filtration products includes the XCell ATF systems and consumables as well as the KrosFlo and SIUS filtration products. Revenue from process analytics products includes the SoloVPE and FlowVPE devices. Revenue from protein products includes the Protein A affinity ligands and cell culture growth factors. Other revenue primarily consists of revenue from the sale of operating room products to hospitals as well as freight revenue.

The following table represents the Company's total revenue by geographic area (based on the location of the customer):

	For the Years Ended December 31,		
	2019	2018	2017
Revenue by customers' geographic locations:			
North America	51%	48%	43%
Europe	37%	40%	46%
APAC	12%	12%	11%
Other	0%	0%	0%
Total revenue	100%	100%	100%

The following table represents the Company's total assets by geographic area:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Total assets by geographic locations:		
North America	$1,260,217	$665,833
Europe	133,599	104,750
APAC	6,297	4,038
Total assets by geographic location	$1,400,113	$774,621

The following table represents the Company's long-lived assets by geographic area:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Long-lived assets by geographic locations:		
North America	$66,756	$26,344
Europe	6,775	5,162
APAC	869	848
Total long-lived assets by geographic location	$74,400	$32,354

Concentrations of Credit Risk and Significant Customers

Financial instruments that subject the Company to significant concentrations of credit risk primarily consist of cash and cash equivalents, marketable securities and accounts receivable. Per the Company's investment policy, cash equivalents and marketable securities are invested in financial instruments with high credit ratings and credit exposure to any one issue, issuer (with the exception of U.S. treasury obligations) and type of instrument is limited. At December 31, 2019 and 2018, the Company had no investments associated with foreign exchange contracts, options contracts or other foreign hedging arrangements.

Concentration of credit risk with respect to accounts receivable is limited to customers to whom the Company makes significant sales. While a reserve for the potential write-off of accounts receivable is maintained, the Company has not written off any significant accounts to date. To control credit risk, the Company performs regular credit evaluations of its customers' financial condition.

Revenue from significant customers that represent 10% or more of the Company's total revenue is as follows:

	For the Years Ended December 31,		
	2019	2018	2017
MilliporeSigma	13%	15%	18%
GE Healthcare	12%	15%	21%

Significant accounts receivable balances representing 10% or more of the Company's total trade accounts receivable and royalties and other receivable balances are as follows:

	December 31,	
	2019	2018
GE Healthcare	18%	17%
MilliporeSigma	N/A	11%

Business Combinations, Goodwill and Intangible Assets

Business Combinations

Total consideration transferred for acquisitions is allocated to the assets acquired and liabilities assumed, if any, based on their fair values at the dates of acquisition. This purchase price allocation process requires management to make significant estimates and assumptions with respect to intangible assets and deferred revenue. The fair value of identifiable intangible assets is based on detailed valuations that use information and assumptions determined by management. Any excess of purchase price over the fair value of the net tangible and intangible assets acquired is allocated to goodwill. While the Company uses its best estimates and assumptions to accurately value assets acquired and liabilities assumed at the acquisition date as well as any contingent consideration, where applicable, that the Company's estimates are inherently uncertain and subject to refinement. As a result,

during the measurement period, which may be up to one year from the acquisition date, the Company records adjustments to the assets acquired and liabilities assumed with the corresponding offset to goodwill. Upon conclusion of the measurement period or final determination of the values of assets acquired or liabilities assumed, whichever comes first, any subsequent adjustments are recorded to the Company's consolidated statements of comprehensive income. Any excess of the fair value of the net tangible and intangible assets acquired over the purchase price is recognized in the consolidated statements of comprehensive income. The fair value of contingent consideration includes estimates and judgments made by management regarding the probability that future contingent payments will be made and the extent of royalties to be earned in excess of the defined minimum royalties. Management updates these estimates and the related fair value of contingent consideration at each reporting period. Changes in the fair value of contingent consideration are recorded in the consolidated statements of comprehensive income.

The Company uses the income approach to determine the fair value of certain identifiable intangible assets including customer relationships and developed technology. This approach determines fair value by estimating after-tax cash flows attributable to these assets over their respective useful lives and then discounting these after-tax cash flows back to a present value. The Company bases its assumptions on estimates of future cash flows, expected growth rates, expected trends in technology, etc. Discount rates used to arrive at a present value as of the date of acquisition are based on the time value of money and certain industry-specific risk factors.

Goodwill

Goodwill is not amortized and is reviewed for impairment at least annually at the reporting unit level. As of December 31, 2018, the Company concluded that it operated as two reporting units and performed the 2018 goodwill impairment test using two reporting units. In 2019, the Company reorganized its reporting structure and changed the way the CODM views the Company's operations and allocates its resources. Accordingly, the Company operates as one reporting unit as of the goodwill impairment measurement date of December 31, 2019. There was no impairment to goodwill at December 31, 2019 and 2018. There were no goodwill impairment charges during the years ended December 31, 2019, 2018 and 2017.

Intangible Assets

Intangible assets with a definite life are amortized over their useful lives using the straight-line method and the amortization expense is recorded within cost of product revenue and selling, general and administrative expense in the consolidated statements of comprehensive income. Intangible assets and their related useful lives are reviewed at least annually to determine if any adverse conditions exist that would indicate the carrying value of these assets may not be recoverable. More frequent impairment assessments are conducted if certain conditions exist, including a change in the competitive landscape, any internal decisions to pursue new or different technology strategies, a loss of a significant customer, or a significant change in the marketplace, including changes in the prices paid for the Company's products or changes in the size of the market for the Company's products. If impairment indicators are present, the Company determines whether the underlying intangible asset is recoverable through estimated future undiscounted cash flows. If the asset is not found to be recoverable, it is written down to the estimated fair value of the asset based on the sum of the future discounted cash flows expected to result from the use and disposition of the asset. If the estimate of an intangible asset's remaining useful life is changed, the remaining carrying amount of the intangible asset is amortized prospectively over the revised remaining useful life. The Company continues to believe that its definitive-lived intangible assets are recoverable at December 31, 2019.

Indefinite-lived intangible assets are reviewed for impairment at least annually. There has been no impairment of our intangible assets for the periods presented.

Stock Based Compensation

The Company measures stock-based compensation cost at the grant date based on the estimated fair value of the award and recognizes it as expense over the employee's requisite service period on a straight-line basis. The

Company records the expense for share-based awards subject to performance-based milestone vesting over the remaining service period when management determines that achievement of the milestone is probable. Management evaluates whether the achievement of a performance-based milestone is probable as of the reporting date. The Company has no awards that are subject to market conditions. The Company recognizes stock-based compensation expense based upon options that are ultimately expected to vest, and accordingly, such compensation expense has been adjusted by an amount of estimated forfeitures.

The Company uses the Black-Scholes option pricing model to calculate the fair value of share-based awards on the grant date. The following assumptions are used in calculating the fair value of share-based awards:

Expected term – The expected term of options granted represents the period of time for which the options are expected to be outstanding. For purposes of estimating the expected term, the Company has aggregated all individual option awards into one group as the Company does not expect substantial differences in exercise behavior among its employees.

Expected volatility – The expected volatility is a measure of the amount by which the Company's stock price is expected to fluctuate during the expected term of options granted. The Company determines the expected volatility based primarily upon the historical volatility of the Company's common stock over a period commensurate with the option's expected term.

Risk-free interest rate – The risk-free interest rate is the implied yield available on U.S. Treasury zero-coupon issues with a remaining term equal to the option's expected term on the grant date.

Expected dividend yield – The Company has never declared or paid any cash dividends on any of its capital stock and does not expect to do so in the foreseeable future. Accordingly, the Company uses an expected dividend yield of zero to calculate the grant-date fair value of a stock option.

Estimated forfeiture rates – The Company has applied, based on an analysis of its historical forfeitures, annual forfeiture rates of 8% for awards granted to non-executive level employees, 3% for awards granted to executive level employees and 0% for awards granted to non-employee members of the Board of Directors to all unvested stock options as of December 31, 2019. The Company reevaluates this analysis periodically and adjusts these estimated forfeiture rates as necessary. Ultimately, the Company will only recognize expense for those shares that vest.

Advertising Costs

The Company expenses advertising costs as they are incurred. Advertising expense for the years ended December 31, 2019, 2018 and 2017 was $0.1 million, $0.2 million and $0.2 million, respectively.

Recent Accounting Standards Updates

The Company considers the applicability and impact of all Accounting Standards Updates on its consolidated financial statements. Updates not listed below were assessed and determined to be either not applicable or are expected to have minimal impact on the Company's consolidated financial position or results of operations. Recently issued Accounting Standards Updates which the Company believes may be applicable are as follows:

Recently Issued Accounting Standard Updates – Not Yet Adopted

In August 2018, the Financial Accounting Standards Board ("FASB") issued ASU 2018-13, *"Fair Value Measurement (Topic 820): Disclosure Framework – Changes to the Disclosure Requirements for Fair Value Measurement."* ASU 2018-13 includes amendments that aim to improve the effectiveness of fair value measurement disclosures. The amendments in this guidance modify the disclosure requirements on fair value

measurements based on the concepts in FASB Concepts Statement, *"Conceptual Framework for Financial Reporting—Chapter 8: Notes to Financial Statements,"* including the consideration of costs and benefits. The amendments become effective for the Company in the year ending December 31, 2020 and early adoption is permitted. The Company will adopt this guidance in the first quarter of 2020 and expects there to be no material impact on its consolidated financial statements.

In August 2018, the FASB issued ASU 2018-15, *"Intangibles – Goodwill and Other – Internal-Use Software (Subtopic 350-40): Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract."* ASU 2018-15 aligns the requirements for capitalizing implementation costs incurred in a hosting arrangement that is a service contract with the requirements for capitalizing implementation costs incurred to develop or obtain internal-use software (and hosting arrangements that include an internal-use software license). The guidance also requires the entity to expense the capitalized implementation costs of a hosting arrangement that is a service contract over the term of the hosting arrangement, which includes reasonably certain renewals. The guidance becomes effective for the Company in the year ending December 31, 2020 and early adoption is permitted. The Company will adopt this guidance in the first quarter of 2020 and expects there to be no material impact on its consolidated financial statements.

In June 2016, the FASB issued ASU 2016-13, "*Financial Instruments-Credit Losses (Topic 326).*" ASU 2016-13 significantly changes how entities will account for credit losses for most financial assets and certain other instruments that are not measured at fair value through net income. ASU 2016-13 replaces the existing incurred loss model with an expected credit loss model that requires entities to estimate an expected lifetime credit loss on most financial assets and certain other instruments, including short-term trade receivables and contract assets, and expands disclosure requirements for credit quality of financial assets. ASU 2016-13 becomes effective for the Company in the year ending December 31, 2020, including interim periods. Early adoption is permitted. The Company will adopt this guidance in the first quarter of 2020. The Company continues to assess all potential impacts that the adoption of this guidance will have on its consolidated financial statements and is continuing to finalize its calculations for credit losses. Based on the composition of the Company's investment portfolio, accounts receivable, current market conditions and historical credit loss activity, the Company does not expect there to be a material impact on its consolidated financial position, results of operations or cash flows.

In December 2019, the FASB issued ASU 2019-12, "*Income Taxes (Topic 740) – Simplifying the Accounting for Income Taxes.*" ASU 2019-12 simplifies the accounting for income taxes by removing certain exceptions to the general principles in Topic 740, including, but not limited to, the exception to the incremental approach for intraperiod tax allocation when there is a loss from continuing operations and income or a gain from other items, the exceptions related to the recognition of a deferred tax liability related to an equity method investment and the exception to methodology for calculating income taxes in an interim period when a year-to-date loss exceeds the anticipated loss for the year. ASU 2019-12 becomes effective for the Company in the year ended December 31, 2021, including interim periods. Early adoption is permitted. The Company is currently assessing the potential impact of the adoption of ASU 2019-12 on its consolidated financial statements.

Recently Issued Accounting Standard Updates – Adopted During the Period

In February 2016, the FASB issued ASU 2016-02, *"Leases (Topic 842)."*ASU 2016-02, along with subsequent ASUs issued to clarify certain provisions of ASU 2016-02 (collectively known as "ASC 842"), establishes a right-of-use ("ROU") model that requires a lessee to record a ROU asset and a lease liability on the consolidated balance sheet for all leases with terms longer than 12 months. Certain qualitative and quantitative disclosures are also required. The Company adopted ASU 2016-02 and related amendments on January 1, 2019 using an optional transition method allowed with the issuance of ASU 2018-11, *"Leases – Targeted Improvements (Topic 842),"* in July 2018. ASU 2018-11 gives entities the option to not provide comparative period financial statements and instead apply the transition requirements as of the effective date of the new standard. Pursuant to additional guidance under ASC 842, the Company also elected the optional package of practical expedients, which allowed the Company to not reassess: (i) whether expired or existing contracts contain leases; (ii) lease

classification for any expired or existing leases; and (iii) initial direct costs for any existing leases. As a result, the consolidated balance sheet prior to January 1, 2019 was not restated, continues to be reported under ASC 840, *"Leases",* which did not require the recognition of operating lease liabilities on the consolidated balance sheet, and is not comparative. Under ASC 842, all leases are required to be recorded on the balance sheet and are classified as either operating leases or finance leases, which is determined at the inception of the lease. The lease classification affects the expense recognition in the consolidated statements of comprehensive income. The expense recognition for operating leases and finance leases under ASC 842 is substantially consistent with ASC 840. Therefore, there is no significant difference in the Company's results of operations presented in its consolidated statements of comprehensive income for each period presented. The Company also elected under the package of practical expedients, to combine lease and non-lease components and not to record leases with an initial term of 12 months or less on the consolidated balance sheet. The Company adopted ASC 842 using the optional transition method for all leases existing at January 1, 2019. The adoption had a substantial impact on the Company's consolidated balance sheet. The most significant impact was the recognition of the operating lease ROU assets and lease liabilities for operating leases. Upon adoption, leases that were classified as operating leases under ASC 840 were classified as operating leases under ASC 842, and the Company recorded ROU assets of $17.0 million and lease liabilities of $21.0 million, before considering deferred taxes. The lease liability is based on the present value of the remaining minimum lease payments, determined under ASC 840, discounted using the Company's incremental borrowing rate at the effective date January 1, 2019. The difference between the ROU assets and the lease liabilities is due to $4.0 million of unamortized lease incentives and deferred rent at the Company's Marlborough and Waltham facilities as of December 31, 2018. There was no impact to the Company's beginning retained earnings upon adoption of ASC 842. See Note 4, *"Leases,"* below for more information on the Company's adoption of ASC 842.

3. Acquisitions

C Technologies

On April 25, 2019, Repligen agreed to acquire C Technologies, pursuant to the terms of a Stock Purchase Agreement (the "Agreement"), by and among Repligen, C Technologies and Craig Harrison, an individual and sole stockholder of C Technologies (such acquisition, the "C Technologies Acquisition").

C Technologies' business consists of two major product categories (i) biotechnology, or Biotech, and (ii) Legacy and Other. Through its Biotech category, C Technologies sells instruments, consumables and accessories that are designed to allow bioprocessing technicians to measure the protein concentration of a liquid sample using C Technologies' Slope Spectroscopy® method, which eliminates the need for manual sample dilution. C Technologies' lead product, the SoloVPE instrument platform, was launched in 2008 for off-line and at-line protein concentration measurements conducted in quality control, process development and manufacturing labs in the production of biological therapeutics. C Technologies' FlowVPE platform, an extension of the SoloVPE technology, was designed to allow end users to make in-line protein concentration measurements in filtration, chromatography and fill-finish applications, designed to allow for real-time process monitoring.

Consideration Transferred

The C Technologies Acquisition was accounted for as a purchase of a business under ASC 805, *"Business Combinations"*. The C Technologies Acquisition was funded through payment of $195.0 million in cash, $186.0 million of which is consideration transferred pursuant to ASC 805, $9.0 million of which will be compensation expense for future employment, and the issuance of 779,221 unregistered shares of the Company's common stock totaling $53.9 million for a total purchase price of $239.9 million. Under the acquisition method of accounting, the assets of C Technologies were recorded as of the acquisition date, at their respective fair values, and consolidated with those of Repligen. The fair value of the net tangible assets acquired was $7.1 million, the fair value of the intangible assets acquired was $90.8 million, and the residual goodwill was $142.0 million.

The consideration and purchase price information has been prepared using a valuation that required the use of significant assumptions and estimates. Critical estimates included, but were not limited to, future expected cash flows, including projected revenues and expenses, and the applicable discount rates. These estimates were based on assumptions that Repligen believes to be reasonable; however, actual results may differ from these estimates.

Total consideration transferred is as follows (amounts in thousands):

Cash consideration	$185,949
Equity consideration	53,938
Fair value of net assets acquired	**$239,887**

Acquisition-related costs are not included as a component of consideration transferred but are expensed in the periods in which the costs are incurred. The Company incurred $4.0 million in transaction costs in 2019. The transaction costs are included in selling, general and administrative expenses in the consolidated statements of comprehensive income. In connection with the transaction, an additional $9.0 million in cash will be due to employees based on their continued employment with the Company one year after the date of the close of the C Technologies Acquisition. For the year ended December 31, 2019, the Company recognized $5.2 million of compensation expense associated with this amount due to employees.

Fair Value of Net Assets Acquired

The allocation of purchase price is based on the fair value of assets acquired and liabilities assumed as of the acquisition date, based on the preliminary valuation. The Company obtains this information during due diligence and through other sources. In the months after closing, the Company may obtain additional information about these assets and liabilities as it learns more about C Technologies and will refine the estimates of fair value to more accurately allocate the purchase price. Only items identified as of the acquisition date are considered for subsequent adjustment. We will make appropriate adjustments to the purchase price allocation, if any, prior to the completion of the measurement period, which is up to one year from the acquisition date. The components and allocation of the purchase price consists of the following amounts (amounts in thousands):

Cash and cash equivalents	$ 3,795
Restricted cash	26,933
Accounts receivable	3,044
Inventory	3,783
Prepaid expenses and other current assets	93
Fixed assets	40
Operating lease right of use asset	3,836
Customer relationships	59,680
Developed technology	28,920
Trademark and tradename	1,570
Non-competition agreements	660
Goodwill	142,021
Deferred taxes	895
Accounts payable	(436)
Accrued liabilities	(2,474)
Accrued bonus	(26,928)
Deferred revenue	(1,709)
Operating lease liability	(51)
Operating lease liability, long-term	(3,785)
Fair value of net assets acquired	**$239,887**

Acquired Goodwill

The goodwill of $142.0 million represents future economic benefits expected to arise from synergies from combining operations and commercial organizations to increase market presence and the extension of existing customer relationships. Substantially all of the goodwill recorded is expected to be deductible for income tax purposes. Pursuant to the Company's business combination accounting policy included in Note 2, *"Summary of Significant Accounting Policies – Business Combinations, Goodwill and Intangible Assets,"* the Company recorded goodwill adjustments for the effects on goodwill of changes to net assets acquired during the period that such change is identified, provided that any such change is within the measurement period (up to one year from the date of the acquisition). In December 2019, the Company recorded a deferred tax asset for the C Technologies Acquisition of $0.9 million as an adjustment to goodwill.

Intangible Assets

The following table sets forth the components of the identified intangible assets associated with the C Technologies Acquisition and their estimated useful lives:

	Useful life	Fair Value
		(Amounts in thousands)
Customer relationships	17 years	$59,680
Developed technology	18 years	28,920
Trademark and tradename	20 years	1,570
Non-competition agreements	4 years	660
Total		$90,830

Revenue, Net Income and Pro Forma Presentation

The Company recorded revenue from C Technologies of $16.4 million and a net loss of $7.4 million from May 31, 2019, the date of acquisition, to December 31, 2019. The Company has included the operating results of C Technologies in its consolidated statements of comprehensive income since the May 31, 2019 acquisition date. The following pro forma financial information presents the combined results of operations of Repligen and C Technologies as if the acquisition had occurred on January 1, 2018 after giving effect to certain pro forma adjustments. These pro forma adjustments include amortization expense on the acquired identifiable intangible assets, adjustments to stock-based compensation expense for equity compensation issued to C Technologies employees and the income tax effect of the adjustments made. In addition, acquisition-related transaction costs and an accounting adjustment to record inventory at fair value were excluded from pro forma net income in 2019.

The following pro forma financial information does not reflect any adjustments for anticipated expense savings resulting from the acquisition and is not necessarily indicative of the operating results that would have actually occurred had the transaction been consummated on January 1, 2018 or of future results:

	December 31,	
	2019	2018
	(Amounts in thousands, except per share data)	
Total revenue	$279,434	$217,739
Net income	$ 23,394	$ 21,195
Earnings per share:		
Basic	$ 0.48	$ 0.44
Diluted	$ 0.48	$ 0.43

Prior to the C Technologies Acquisition, C Technologies did not generate monthly or quarterly financial statements that were prepared in accordance with U.S. GAAP.

Spectrum LifeSciences, LLC

On August 1, 2017, the Company completed the acquisition of Spectrum pursuant to the terms of an Agreement and Plan of Merger and Reorganization, dated as of June 22, 2017 (such acquisition, the "Spectrum Acquisition").

Spectrum is a diversified filtration company with a differentiated portfolio of hollow fiber ("HF") cartridges, benchtop to commercial scale filtration and perfusion systems and a broad portfolio of disposable and single-use solutions. Spectrum's products are primarily used for the filtration, isolation, purification and concentration of monoclonal antibodies, vaccines, recombinant proteins, diagnostic products and cell therapies where the Company offers both standard and customized solutions to its bioprocessing customers.

Spectrum's filtration products include its KrosFlo line of hollow fiber cartridges, TFF systems and single-use flow path consumables, as well as its Spectra/Por® portfolio of laboratory dialysis products and its ProConnex single-use hollow fiber Module-Bag-Tubing sets. Outside of filtration, Spectrum products include Spectra/Chrom® liquid chromatography products for research applications. These bioprocessing products account for the majority of Spectrum revenues. Spectrum also offers a line of operating room products.

Consideration Transferred

The Company accounted for the Spectrum Acquisition as a purchase of a business under ASC 805, *"Business Combinations."* The Spectrum Acquisition was funded through payment of $122.9 million in cash, the issuance of 6,153,995 unregistered shares of the Company's common stock totaling $247.6 million and a working capital adjustment of $0.4 million for a total purchase price of $370.9 million. Under the acquisition method of accounting, the assets of Spectrum were recorded as of the acquisition date, at their respective fair values, and consolidated with those of the Company. The fair value of the net assets acquired was $370.9 million.

The consideration and purchase price information has been prepared using a valuation that required the use of significant assumptions and estimates in its preparation. Critical estimates included, but were not limited to, future expected cash flows, including projected revenues and expenses, and the applicable discount rates. These estimates were based on assumptions that the Company believes to be reasonable; however, actual results may differ from these estimates.

The total consideration transferred follows (amounts in thousands):

Cash consideration	$122,932
Equity consideration	247,575
Working capital adjustment	425
Net assets acquired	**$370,932**

Acquisition-related costs are not included as a component of consideration transferred but are expensed in the periods in which the costs are incurred. The Company incurred $2.9 million and $7.1 million in integration costs related to the Spectrum Acquisition in 2018 and 2017, respectively. These costs are primarily included in selling, general and administrative expenses in the consolidated statements of comprehensive income.

Revenue, Net Income and Pro Forma Presentation

The Company recorded revenue from Spectrum of $19.4 million from August 1, 2017 through December 31, 2017. The Company has included the operating results of Spectrum in its consolidated statements of comprehensive income since the August 1, 2017 acquisition date. The following table presents unaudited

supplemental pro forma information as if the Spectrum Acquisition had occurred as of January 1, 2017 (amounts in thousands, except per share data):

	December 31, 2017
Total revenue	$162,913
Net income (loss)	$ 17,220
Earnings (loss) per share:	
Basic	$ 0.41
Diluted	$ 0.40

The unaudited pro forma information for the years ended December 31, 2017 was calculated after applying the Company's accounting policies and the impact of acquisition date fair value adjustments. Unaudited pro forma net income for year ended December 31, 2017 was adjusted to exclude acquisition-related transaction costs, nonrecurring expenses related to the fair value adjustments associated with the acquisition and income tax benefits resulting from the acquisition. In addition, the unaudited pro forma net income for the year ended December 31, 2017 was adjusted to include incremental amortization of intangible assets. These items have been factored to the unaudited pro forma net income for the year ended December 31, 2017.

These pro forma condensed consolidated financial results have been prepared for comparative purposes only and include certain adjustments to reflect the pro forma results of operations as if the acquisition had occurred as of the beginning of the periods presented, such as fair value adjustments to inventory and increased amortization for the fair value of acquired intangible assets. The pro forma information does not reflect the effect of costs or synergies that would have been expected to result from the integration of the acquisition. The pro forma information does not purport to be indicative of the results of operations that actually would have resulted had the combination occurred at the beginning of each period presented, or of future results of the consolidated entities.

4. Leases

On January 1, 2019, the Company adopted ASC 842 using the optional transition method which allows entities to initially apply the lease accounting transition requirements at the adoption date and recognize a cumulative effect adjustment to the opening balance sheet of retained earnings in the period of adoption without restating comparative prior periods presented. The Company recorded operating lease right of use assets of $17.0 million and operating lease liabilities of $21.0 million as of January 1, 2019. The difference between the right of use assets and the lease liabilities was due to $4.0 million of unamortized lease incentives and deferred rent at the Company's Waltham and Marlborough facilities as of December 31, 2018.

The Company is a lessee under leases of manufacturing facilities, office spaces, machinery, certain office equipment, vehicles and information technology equipment. A majority of the Company's leases are operating leases with remaining lease terms between two months and 11 years. Finance leases are immaterial to the Company's consolidated financial statements. The Company determines if an arrangement qualifies as a lease and what type of lease it is at inception. The Company elected the package of practical expedients permitted under the transition guidance within the new lease standard, which among other things, allowed it to continue to account for existing leases based on the historical lease classification. The Company also elected the practical expedients to combine lease and non-lease components and to exclude right of use assets and lease liabilities for leases with an initial term of 12 months or less from the balance sheet.

Some of the lease agreements the Company enters into include Company options to either extend and/or early terminate the lease, the costs of which are included in the Company's operating lease liabilities to the extent that such options are reasonably certain of being exercised. Leases with renewal options allow the Company to extend the lease term typically between 1 and 5 years per option, some of its leases have multiple options to extend.

When determining if a renewal option is reasonably certain of being exercised, the Company considers several economic factors, including but not limited to, the significance of leasehold improvements incurred on the property, whether the asset is difficult to replace, underlying contractual obligations, or specific characteristics unique to that particular lease that would make it reasonably certain that the Company would exercise such options.

As of December 31, 2019, operating lease right of use assets were $25.7 million and operating lease liabilities were $30.6 million. Two material leases, as defined under ASC 842, to expand the Company's facility in Waltham, Massachusetts commenced during the third quarter of 2019. As a result, the operating right of use asset and operating lease liability balances increased by a total of $6.1 million on their commencement dates. Amounts related to financing leases were immaterial. The maturity of the Company's operating lease liabilities as of December 31, 2019 are as follows (amounts in thousands):

As of December 31, 2019	Amount
2020	$ 3,692
2021	5,812
2022	4,830
2023	3,911
2024	3,514
2025 and thereafter	16,511
Total future minimum lease payments	38,270
Less: amount of lease payment representing interest	7,718
Total operating lease liabilities	$30,552

Total operating lease liabilities is included on the Company's consolidated balance sheet is as follows (amounts in thousands):

	As of December 31, 2019
Operating lease liability	$ 3,557
Operating lease liability, long-term	26,995
Minimum operating lease payments	$30,552

Lease expense for these leases is recognized on a straight-line basis over the lease term, with variable lease payments recognized in the period those payments are incurred. For the year ended December 31, 2019, total lease cost is comprised of the following:

Lease Cost	Year Ended December 31, 2019
	(Amounts in thousands)
Operating lease cost	$4,480
Variable operating lease cost	1,480
Lease cost	$5,960

The following information represents supplemental disclosure for the consolidated statements of cash flows related to operating leases (amounts in thousands):

	Year Ended December 31, 2019
Operating cash flows from operating leases	$(4,004)

Most of the leases do not provide implicit interest rates and therefore the Company determines the discount rate based on its incremental borrowing rate. The incremental borrowing rate for the Company's leases is determined based on lease term and currency in which the lease payments are made.

The weighted average remaining lease term and the weighted average discount rate used to measure the Company's operating lease liabilities as of December 31, 2019 were:

Weighted average remaining lease term (years)	8.05
Weighted average discount rate	4.91%

5. Revenue Recognition

Adoption of ASC Topic 606, Revenue from Contracts with Customers

The Company adopted ASC 606 on January 1, 2018, using the modified retrospective method for all contracts not completed as of the date of adoption. For contracts that were modified before the effective date, the Company reflected the aggregate effect of all modifications when identifying performance obligations and allocating transaction price in accordance with the practical expedient in paragraph ASC 606-10-65-1-(f)-4, which did not have a material effect on the cumulative impact of adopting ASC 606. Results for reporting periods beginning January 1, 2018 are presented under ASC 606, while prior period amounts are not adjusted and continue to be reported under the accounting standards in effect for the prior period. The impact to the Company's consolidated financial statements as a result of applying ASC 606 was immaterial. Deferred revenue resulting from contracts with customers is included in accrued expenses on the Company's consolidated balance sheets.

Disaggregation of Revenue

Revenue for the years ended December 31, 2019, 2018 and 2017 was as follows (amounts in thousands, except percentages):

	For the Years Ended December 31,		
	2019	2018	2017
	(Amounts in thousands)		
Product revenue	$270,097	$193,891	$141,089
Royalty and other income	148	141	147
Total revenue	$270,245	$194,032	$141,236

When disaggregating revenue, the Company considered all of the economic factors that may affect its revenues. Because all of its revenues are from bioprocessing customers, there are no differences in the nature, timing and uncertainty of the Company's revenues and cash flows from any of its product lines. However, given that the Company's revenues are generated in different geographic regions, factors such as regulatory and geopolitical factors within those regions could impact the nature, timing and uncertainty of the Company's revenues and cash flows. In addition, a significant portion of the Company's revenues are generated from two customers; therefore, economic factors specific to these two customers could impact the nature, timing and uncertainty of the Company's revenues and cash flows.

Disaggregated revenue from contracts with customers by geographic region can be found in Note 2., *"Summary of Significant Accounting Policies – Segment Reporting,"* above.

Revenue from significant customers is as follows (amounts in thousands):

	For the Years Ended December 31,		
	2019	2018	2017
MilliporeSigma	$36,190	$29,843	$25,061
GE Healthcare	$31,441	$29,616	$30,150

Chromatography Products

The Company's chromatography products include a number of products used in the downstream purification and quality control of biological drugs. The majority of chromatography revenue relates to the OPUS pre-packed chromatography column line and Protein A chromatography resins. OPUS columns typically consist of the outer hardware of the column with a resin as ordered by the customer packed inside of the column. OPUS columns may also be ordered without the packed resin. In either scenario, the OPUS column and resin are not interdependent of one another and are therefore considered distinct products that represent separate performance obligations. Chromatography product revenue is generally recognized at a point in time upon transfer of control to the customer.

Filtration Products

The Company's filtration products generate revenue through the sale of KrosFlo HF TFF membranes and modules, ProConnex single-use flow path assemblies, flat sheet TFF cassettes and hardware, and XCell ATF devices and related consumables.

The Company markets its portfolio of HF filtration solutions, including our KrosFlo TFF Systems with Konduit monitor and the ProConnex line of single-use flow path assemblies which were acquired as part of the acquisition of Spectrum LifeSciences, LLC (the "Spectrum Acquisition"). These products are used in the filtration, isolation, purification and concentration of biologics and diagnostic products. Sales of large-scale systems generally include components and consumables as well as training and installation services at the request of the customer. Because the initial sale of components and consumables are necessary for the operation of the system, such items are combined with the systems as a single performance obligation. Training and installation services do not significantly modify or customize these systems and therefore represent a distinct performance obligation.

The Company's other filtration product offerings are not highly interdependent of one another and are therefore considered distinct products that represent separate performance obligations. Revenue on these products is generally recognized at a point in time upon transfer of control to the customer. The Company invoices the customer for the installation and training services in an amount that directly corresponds with the value to the customer of the Company's performance to date; therefore, revenue recognized is based on the amount billable to the customer in accordance with the practical expedient under ASC 606-10-55-18.

The Company also markets flat sheet TFF cassettes and hardware. TFF is a rapid and efficient method for separation and purification of biomolecules that is widely used in laboratory, process development and process scale applications in biopharmaceutical manufacturing. The Company's single-use SIUS TFF cassettes and hardware are not highly interdependent of one another and are therefore considered distinct products that represent separate performance obligations. Product revenue from the sale off SIUS TFF Cassettes and hardware is generally recognized at a point in time upon transfer of control to the customer.

The Company also markets the XCell ATF system, a technologically advanced filtration device used in upstream processes to continuously remove cellular metabolic waste products during the course of a fermentation run, freeing healthy cells to continue producing the biologic drug of interest. XCell ATF systems typically include a filtration system and consumables (i.e., tube devices, metal stands) as well as training and installation services at the request of the customer. The filtration system and consumables are considered distinct products and therefore represent separate performance obligations. First time purchasers of the systems typically purchase a controller that is shipped with the tube device(s) and metal stand(s). The controller is not considered distinct as it is a proprietary product that is highly interdependent with the filtration system; therefore, the controller is combined with the filtration system and accounted for as a single performance obligation. The training and installation services do not significantly modify or customize the XCell ATF system and therefore represent a distinct performance obligation. XCell ATF system product revenue related to the filtration system (including the controller if applicable) and consumables is generally recognized at a point in time upon transfer of control to the

customer. XCell ATF system service revenue related to training and installation services is generally recognized over time, as the customer simultaneously receives and consumes the benefits as the Company performs. The Company invoices the customer for the installation and training services in an amount that directly corresponds with the value to the customer of the Company's performance to date; therefore, revenue recognized is based on the amount billable to the customer in accordance with the practical expedient under ASC 606-10-55-18.

Process Analytics Products

On May 31, 2019, the Company consummated its acquisition of C Technologies and added a fourth franchise, Process Analytics, to its bioprocessing business. The Process Analytics franchise generates revenue primarily through the sale of the SoloVPE and FlowVPE Slope Spectroscopy systems. These products will complement and support the Company's existing Filtration, Chromatography and Proteins franchises as they allow end users to make in-line protein concentration measurements in filtration, chromatography and fill-finish applications, designed to allow for real-time process monitoring.

Protein Products

The Company's Protein franchise generates revenue through the sale of Protein A affinity ligands and growth factors. Protein A ligands are an essential component of Protein A chromatography resins (media) used in the purification of virtually all mAb-based drugs on the market or in development. The Company manufactures multiple forms of Protein A ligands under long-term supply agreements with major life sciences companies, who in turn sell their Protein A chromatography media to end users (biopharmaceutical manufacturers). The Company also manufactures growth factors for sale under long-term supply agreements with certain life sciences companies as well as direct sales to its customers. Each protein product is considered distinct and therefore represents a separate performance obligation. Protein product revenue is generally recognized at a point in time upon transfer of control to the customer.

Other Products

The Company's other products include operating room products sold to hospitals. Other product revenue is generally recognized at a point in time upon transfer of control to the customer.

Transaction Price Allocated to Future Performance Obligations

Remaining performance obligations represents the transaction price of contracts for which work has not been performed or has been partially performed. The Company's future performance obligations relate primarily to the installation and training of certain of its systems sold to customers. These performance obligations are completed within one year of receipt of a purchase order from its customers. Accordingly, the Company has elected to not disclose the value of these unsatisfied performance obligations as provided under ASC 606-10-50-14.

Contract Balances from Contracts with Customers

The following table provides information about receivables and deferred revenue from contracts with customers as of December 31, 2019 (amounts in thousands):

	2019
Balances from contracts with customers only:	
Accounts receivable	$43,068
Deferred revenue (included in accrued liabilities in the consolidated balance sheets)	5,005
Revenue recognized during 2019 relating to:	
The beginning deferred revenue balance	$ 833
Changes in pricing related to products or services satisfied in previous periods	—

The timing of revenue recognition, billings and cash collections results in the accounts receivables and deferred revenue balances on the Company's consolidated balance sheets. There were no impairment losses on receivables during the year ending December 31, 2019.

A contract asset is created when the Company satisfies a performance obligation by transferring a promised good to the customer. Contract assets may represent conditional or unconditional rights to consideration. The right is conditional, and recorded as a contract asset, if the Company must first satisfy another performance obligation in the contract before it is entitled to payment from the customer. Contract assets are transferred to billed receivables once the right becomes unconditional. If the Company has the unconditional right to receive consideration from the customer, the contract asset is accounted for as a billed receivable and presented separately from other contract assets. A right is unconditional if nothing other than the passage of time is required before payment of that consideration is due.

When consideration is received, or such consideration is unconditionally due, from a customer prior to transferring goods or services to the customer under the terms of a contract, a contract liability is recorded. Contract liabilities are recognized as revenue after control of the products or services is transferred to the customer and all revenue recognition criteria have been met.

Costs to Obtain or Fulfill a Customer Contract

The Company's sales commission structure is based on achieving revenue targets. The commissions are driven by revenue derived from customer purchase orders which are short term in nature.

Applying the practical expedient in paragraph 340-40-25-4, the Company recognizes the incremental costs of obtaining contracts as an expense when incurred if the amortization period of the assets that the Company otherwise would have recognized is one year or less. These costs are included in selling, general, and administrative expenses. When shipping and handling costs are incurred after a customer obtains control of the products, the Company accounts for these as costs to fulfill the promise and not as a separate performance obligation.

6. Goodwill and Intangible Assets

Goodwill

Goodwill represents the difference between the purchase price and the estimated fair value of identifiable assets acquired and liabilities assumed. Goodwill acquired in a business combination and determined to have an indefinite useful life is not amortized, but instead is tested for impairment at least annually in accordance with ASC 350. The following table represents the changes in the carrying value of goodwill for the years ended December 31, 2019 and 2018 (amounts in thousands):

Balance as of December 31, 2017	$327,333
Goodwill adjustment related to Spectrum Lifesciences, LLC acquisition	203
Cumulative translation adjustment	(801)
Balance as of December 31, 2018	$326,735
Acquisition of C Technologies, Inc.	142,021
Cumulative translation adjustment	(343)
Balance as of December 31, 2019	$468,413

(1) In December 2019, the Company recorded a deferred tax asset for the C Technologies acquisition of $0.9 million as an adjustment to goodwill.

During each of the fourth quarters of 2019, 2018 and 2017, the Company completed its annual impairment assessments and concluded that goodwill was not impaired in any of those years.

Intangible Assets

Intangible assets with a definitive life are amortized over their useful lives using the straight-line method and the amortization expense is recorded within cost of product revenue and selling, general and administrative expense in the Company's consolidated statements of comprehensive income. Intangible assets and their related useful lives are reviewed at least annually to determine if any adverse conditions exist that would indicate the carrying value of these assets may not be recoverable. More frequent impairment assessments are conducted if certain conditions exist, including a change in the competitive landscape, any internal decisions to pursue new or different technology strategies, a loss of a significant customer, or a significant change in the marketplace, including changes in the prices paid for the Company's products or changes in the size of the market for the Company's products. If impairment indicators are present, the Company determines whether the underlying intangible asset is recoverable through estimated future undiscounted cash flows. If the asset is not found to be recoverable, it is written down to the estimated fair value of the asset based on the sum of the future discounted cash flows expected to result from the use and disposition of the asset. If the estimate of an intangible asset's remaining useful life is changed, the remaining carrying amount of the intangible asset is amortized prospectively over the revised remaining useful life. The Company continues to believe that its definite-lived intangible assets are recoverable at December 31, 2019.

Indefinite-lived intangible assets are tested for impairment at least annually. There has been no impairment of our intangible assets for the periods presented.

Intangible assets, net consisted of the following at December 31, 2019:

	December 31, 2019			
	Gross Carrying Value	Accumulated Amortization	Net Carrying Value	Weighted Average Useful Life (in years)
	(Amounts in thousands)			
Finite-lived intangible assets:				
Technology - developed	$ 82,169	$ (9,669)	$ 72,500	19
Patents	240	(240)	—	8
Customer relationships	160,825	(25,642)	135,183	15
Trademarks	3,752	(333)	3,419	20
Other intangibles	1,697	(947)	750	3
Total finite-lived intangible assets	248,683	(36,831)	211,852	16
Indefinite-lived intangible asset:				
Trademarks	700	—	700	—
Total intangible assets	$249,383	$(36,831)	$212,552	

Intangible assets consisted of the following at December 31, 2018:

	December 31, 2018			
	Gross Carrying Value	Accumulated Amortization	Net Carrying Value	Weighted Average Useful Life (in years)
	(Amounts in thousands)			
Finite-lived intangible assets:				
Technology - developed	$ 53,315	$ (5,942)	$ 47,373	19
Patents	240	(240)	—	8
Customer relationships	101,460	(16,609)	84,851	14
Trademarks	2,160	(159)	2,001	20
Other intangibles	1,061	(548)	513	3
Total finite-lived intangible assets	158,236	(23,498)	134,738	16
Indefinite-lived intangible asset:				
Trademarks	700	—	700	—
Total intangible assets	$158,936	$(23,498)	$135,438	

Amortization expense for finite-lived intangible assets was $13.6 million, $10.6 million and $6.2 million for the years ended December 31, 2019, 2018 and 2017, respectively. As of December 31, 2019, the Company expects to record the following amortization expense (amounts in thousands):

For the Years Ended December 31,	Estimated Amortization Expense
2020	$ 15,288
2021	14,813
2022	14,811
2023	14,715
2024	14,273
2025 and thereafter	137,952
Total	$211,852

7. Consolidated Balance Sheet Detail

Inventories, net

Inventories, net consists of the following:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Raw materials	$29,328	$24,937
Work-in-process	8,360	5,185
Finished products	17,144	12,141
Total inventories, net	$54,832	$42,263

Prepaid Expenses and Other Current Assets

Prepaid expenses and other current assets consist of the following:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Equipment maintenance and services	$1,662	$1,677
Prepaid taxes	2,719	843
Prepaid insurance	80	629
Deferred costs	—	55
Other	1,456	697
Total prepaid expenses and other current assets	$5,917	$3,901

Property, Plant and Equipment

Property, plant and equipment consist of the following:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Land	$ 1,023	$ 1,023
Buildings	764	764
Leasehold improvements	23,905	16,259
Equipment	36,257	24,092
Furniture, fixtures and office equipment	6,312	4,914
Computer hardware and software	8,810	534
Construction in progress[(1)]	6,707	12,906
Other	56	—
Total property, plant and equipment	83,834	60,492
Less - Accumulated depreciation	(35,379)	(28,312)
Total property, plant and equipment, net	$ 48,455	$ 32,180

(1) Construction in progress as of December 31, 2019 primarily includes $4.2 million for the buildout of the Company's Waltham and Marlborough, Massachusetts facilities, $1.1 million of other manufacturing improvements in Waltham and Marlboro, $0.6 million in manufacturing improvements at the Company's Rancho Dominguez, California facility and $0.4 million for a buildout at the Company's Bridgewater, New Jersey facility. Construction in progress as of December 31, 2018 includes $7.3 million for the buildout of the Company's Marlborough facility, $2.1 million in capitalized internal-use software development costs and $2.1 million for a casting machine, among other projects.

Depreciation expense totaled $7.3 million, $5.2 million and $4.2 million in the fiscal years ended December 31, 2019, 2018 and 2017, respectively.

Accrued Liabilities

Accrued liabilities consist of the following:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Employee compensation	$19,850	$ 9,953
Taxes	3,874	1,024
Royalty and license fees	123	242
Warranties	1,500	546
Professional fees	1,081	942
Deferred revenue	5,005	1,290
Other	1,898	1,868
Total accrued liabilities	$33,331	$15,865

8. Income Taxes

The components of income before income taxes are as follows:

	For the Years Ended December 31,		
	2019	2018	2017
	(Amounts in thousands)		
Domestic	$ (5,432)	$ (73)	$ (6,709)
Foreign	31,583	21,509	13,957
Income before income taxes	$26,151	$21,436	$ 7,248

The components of the income tax provision (benefit) are as follows:

	For the Years Ended December 31,		
	2019	2018	2017
	(Amounts in thousands)		
Components of the income tax provision (benefit):			
Current	$ 8,290	$4,354	$ 3,624
Deferred	(5,287)	465	(24,729)
Equity	1,737	—	—
Total	$ 4,740	$4,819	$(21,105)
Jurisdictional components of the income tax provision (benefit):			
Federal	$ (965)	$ (393)	$(24,012)
State	(1,764)	718	(438)
Foreign	7,469	4,494	3,345
Total	$ 4,740	$4,819	$(21,105)

During 2019, the Company generated $0.1 million in foreign net operating losses and $0.2 million in state net operating losses. During 2018, the Company utilized its remaining U.S. net operating loss carryforwards of $19.5 million. At December 31, 2019, the Company had federal business tax credit carryforwards of $1.2 million and state business tax credit carryforwards of $0.9 million available to reduce future domestic income taxes. The business tax credits carryforwards will expire at various dates through December 2039. The business tax credit carryforwards are subject to review and possible adjustment by the Internal Revenue Service and may be limited in the event of certain changes in the ownership interest of significant stockholders.

The components of deferred income taxes are as follows:

	December 31,	
	2019	2018
	(Amounts in thousands)	
Deferred tax assets:		
Temporary timing differences:		
Stock-based compensation expense	$ 2,922	$ 2,874
Contingent consideration	2,206	2,263
Operating leases	7,295	—
Accrued bonus	1,379	3
Other	4,994	3,585
Total temporary timing differences	18,796	8,725
Net operating loss carryforwards	221	—
Tax business credits carryforwards	924	2,004
Total deferred tax assets	19,941	10,729
Less: valuation allowance	(6)	(131)
Net deferred tax assets	19,935	10,598
Deferred tax liabilities:		
Goodwill	(1,288)	(1,076)
Fixed assets	(1,650)	(956)
Acquired intangible assets	(26,811)	(26,903)
Operating lease right of use assets	(6,144)	—
Conversion option on convertible notes	(11,066)	(2,394)
Total deferred tax liabilities	(46,959)	(31,329)
Total net deferred tax liabilities	$(27,024)	$(20,731)

The net change in the total valuation allowance for the year ended December 31, 2019 and 2018 was a decrease of $0.1 million and an increase of $0.1 million, respectively.

The reconciliation of the federal statutory rate to the effective income tax rate for the years ended December 31, 2019, 2018 and 2017 is as follows:

	For the Years Ended December 31,					
	2019		2018		2017	
	Amount	%	Amount	%	Amount	%
	(Amounts in thousands, except percentages)					
Income before income taxes	$26,151		$21,436		$ 7,248	
Expected tax at statutory rate	5,492	21.0%	4,502	21.0%	2,537	35.0%
Adjustments due to:						
Difference between U.S. and foreign tax	436	1.7%	345	1.6%	(1,797)	(24.8%)
State income and franchise tax	(179)	(0.7%)	91	0.4%	(307)	(4.2%)
Business tax credits	(2,746)	(10.5%)	(1,760)	(8.2%)	(708)	(9.8%)
Permanent differences:						
Stock-based compensation expense	(1,877)	(7.2%)	(1,213)	(5.7%)	(946)	(13.1%)
Transaction costs	—	0.0%	—	0.0%	1,232	17.0%
U.S. taxation of foreign earnings	2,227	8.5%	2,190	10.2%	—	0.0%
Executive compensation	841	3.2%	367	1.7%	265	3.7%
Other	92	0.4%	97	0.5%	205	2.8%
Change in U.S. federal tax rates	—	0.0%	—	0.0%	(12,839)	(177.1%)
Change in U.S. state tax rates	—	0.0%	748	3.5%	(151)	(2.1%)
Change in Netherlands tax rate	(193)	(0.7%)	(388)	(1.8%)	—	0.0%
Transition tax	—	0.0%	(1,338)	(6.2%)	3,266	45.1%
Uncertain tax provisions	1,069	4.1%	1,021	4.8%	241	3.3%
Change in valuation allowance	(125)	(0.5%)	125	0.6%	(12,164)	(167.8%)
Return to provision adjustments	(79)	(0.3%)	33	0.2%	(161)	(2.2%)
Other	(218)	(0.8%)	(1)	(0.1%)	222	3.0%
Income tax provision (benefit)	$ 4,740	18.1%	$ 4,819	22.5%	$(21,105)	(291.2%)

The Company's tax returns are subject to examination by federal, state and international taxing authorities for the following periods:

Jurisdiction	Fiscal Years Subject to Examination
United States – federal and state	2016-2019
Sweden	2012-2019
Germany	2017-2019
Netherlands	2013-2019

The following is a tabular reconciliation of the total amounts of unrecognized tax benefits:

	For the Years Ended December 31,	
	2019	2018
	(Amounts in thousands)	
Balance of gross unrecognized tax benefits, beginning of period	$2,852	$1,806
Gross amounts of increases in unrecognized tax benefits as a result of tax positions taken in the current period	602	1,062
Gross amounts of decreases in unrecognized tax benefits as a result of tax positions taken in the prior period	(16)	—
Gross amounts of decrease due to release	(16)	(16)
Balance of gross unrecognized tax benefits, end of period	$3,422	$2,852

Included in the balance of unrecognized tax benefits as of December 31, 2019 are $3.4 million of tax benefits that, if recognized, would affect the effective tax rate. The Company classifies interest and penalties related to income taxes as components of its income tax provision. The amount of interest and penalties recorded in the accompanying consolidated statements of comprehensive income was approximately $5,000 for the year ended December 31, 2019 and approximately $1,000 for the years ended December 31, 2018 and 2017, respectively. The amount of interest and penalties recorded in the accompanying consolidated balance sheets was approximately $41,000 and $46,000 as of December 31, 2019 and 2018, respectively. The Company does not anticipate the amount of unrecognized tax benefits to change over the next twelve months.

As of December 31, 2019, the Company has accumulated undistributed earnings generated by its foreign subsidiaries of approximately $93.5 million. Because $58.0 million of such earnings have previously been subject to the one-time transition tax on foreign earnings required by the 2017 Tax Act, any additional taxes due with respect to such earnings or the excess of the amount for financial reporting over the tax basis of the Company's foreign investments would generally be limited to foreign and state taxes. At December 31, 2019, the Company has not provided for taxes on outside basis differences of its foreign subsidiaries, as the Company has the ability and intent to indefinitely reinvest the undistributed earnings of its foreign subsidiaries, and there are no needs for such earnings in the United States that would contradict its plan to indefinitely reinvest.

ASU 2016-16,*"Intra-Entity Transfers of Assets Other Than Inventory,"* requires the income tax consequences of intra-entity transfers of assets other than inventory to be recognized when the intra-entity transfer occurs rather than deferring recognition of income tax consequences until the transfer was made with an outside party. The Company adopted the provisions of this ASU in the first quarter of 2018. The adoption resulted in a decrease of $5.7 million to other assets, a decrease of $5.0 million to deferred tax liabilities and a decrease of $0.7 million to accumulated deficit at January 1, 2018.

On December 22, 2017, President Trump signed into law H.R. 1/Public Law No. 115-97, the tax legislation commonly known as the Tax Cuts and Jobs Act (the "2017 Tax Act"). The Act made significant changes to federal tax law, including, but not limited to, a reduction in the federal income tax rate from 35% to 21%, taxation of certain global intangible low-taxed income, allowing for immediate expensing of qualified assets, stricter limits on deductions for interest and certain executive compensation, and a one-time transition tax on previously deferred earnings of certain foreign subsidiaries.

In December 2017, the SEC staff issued Staff Accounting Bulletin No. 118 ("SAB 118") to address the application of GAAP in situations when a registrant does not have the necessary information available, prepared, or analyzed (including computations) in reasonable detail to complete the accounting for certain income tax effects of H.R.1. The Company recognized the provisional tax impacts related to deemed repatriated earnings and the revaluation of deferred tax assets and liabilities and included these amounts in its consolidated financial statements for the year ended December 31, 2017. During 2018, final adjustments noted below have been made to the provisional amounts recorded during 2017, and the Company has now completed its accounting for various tax impacts of the Act.

The Act lowered the Company's U.S. statutory federal tax rate from 35% to 21% effective January 1, 2018. The Company recorded a tax benefit of $12.8 million in the year ended December 31, 2017 for the reduction in its US deferred tax assets and liabilities resulting from the rate change. The accounting for this item is complete and no adjustments were made to this amount during 2018.

The Act included a one-time deemed repatriation transition tax whereby entities that are shareholders of a specified foreign corporation must include in gross income the undistributed and previously untaxed post-1986 earnings and profits of the specified foreign corporation. The Company's provisional amount recorded at December 31, 2017 increased its tax provision by $3.3 million. As of December 31, 2018, the accounting for this item was complete.

The Company is subject to a territorial tax system under the Act, in which the Company is required to provide for tax on Global Intangible Low-Taxed Income ("GILTI") earned by certain foreign subsidiaries. The Company has adopted an accounting policy to provide for the tax expense related to GILTI in the year the tax is incurred as a period expense.

9. Stockholders' Equity

Public Offerings of Common Stock

On July 19, 2019, the Company completed a public offering in which 1,587,000 shares of its common stock, including the underwriters' exercise in full of an option to purchase an additional 207,000 shares, were sold to the public at a price of $87.00 per share (the "July Stock Offering"). The net proceeds of the Stock Offering, after deducting underwriting discounts and commissions and other estimated offering expenses payable by the Company, were approximately $131.1 million.

On May 3, 2019, the Company completed a public offering in which 3,144,531 shares of its common stock, including the underwriters' full exercise of an option to purchase up to an additional 410,156 shares, were sold to the public at a price of $64.00 per share. The total proceeds received by the Company from this offering, net of underwriting discounts and commissions and other estimated offering expenses payable by the Company, totaled approximately $189.6 million.

On July 3, 2017, the Company completed a public offering in which 2,807,017 shares of its common stock were sold to the public at a price of $42.75 per share. The underwriters were granted an option, which they exercised in full, to purchase an additional 421,052 shares of the Company's common stock. The total proceeds from this offering, net of underwriting discounts, commissions and other offering expenses, totaled $129.3 million.

Stock Option and Incentive Plans

At the Company's 2018 Annual Meeting of Stockholders held on May 16, 2018, the Company's shareholders approved the 2018 Stock Option and Incentive Plan (the "2018 Plan"). Under the 2018 Plan the number of shares of the Company's common stock that are reserved and available for issuance shall be 2,778,000 plus the number of shares of common stock available for issuance under the Company's Amended and Restated 2012 Stock Option and Incentive Plan (the "2012 Plan"). The shares of common stock underlying any awards under the 2018 Plan, 2012 Plan and the Second Amended and Restated 2001 Repligen Corporation Stock Plan (the "2001 Plan," and together with the 2018 Plan and 2012 Plan, the "Plans") that are forfeited, canceled or otherwise terminated (other than by exercise) shall be added back to the shares of stock available for issuance under the 2018 Plan. At December 31, 2019, 2,555,281 shares were available for future grant under the 2018 Plan.

Stock-Based Compensation

The Company recorded stock-based compensation expense of $12.8 million, $10.2 million and $6.7 million for the years ended December 31, 2019, 2018 and 2017, respectively, for share-based awards granted under the Plans. The following table presents stock-based compensation expense in the Company's consolidated statements of comprehensive income:

	For the Years Ended December 31,		
	2019	2018	2017
	(Amounts in thousands)		
Cost of product revenue	$ 1,368	$ 1,019	$ 704
Research and development	1,373	917	481
Selling, general and administrative	10,106	8,256	5,562
Total stock-based compensation	$12,847	$10,192	$6,747

The 2018 Plan allows for the granting of incentive and nonqualified options to purchase shares of common stock, restricted stock and other equity awards. Except for the grant to the Company's Chief Executive Officer ("CEO") in 2018 mentioned below, employee grants under the Plans generally vest over a three- to five-year period, with 20%-33% vesting on the first anniversary of the date of grant and the remainder vesting in equal yearly installments thereafter. Nonqualified options issued to non-employee directors and consultants under the Plans generally vest over one year. In the first quarter of 2018, to create a longer-term retention incentive, the Company's Compensation Committee granted long-term incentive compensation awards to its CEO which consisted of both stock options and restricted stock units that are subject to time-based vesting over nine years. Options granted under the Plans have a maximum term of ten years from the date of grant and generally, the exercise price of the stock options equals the fair market value of the Company's common stock on the date of grant. At December 31, 2019, options to purchase 957,559 shares and 734,984 stock units were outstanding under the Plans.

The Company uses the Black-Scholes option pricing model to calculate the fair value of stock option awards on the grant date, and the Company uses the value of the common stock as of the grant date to value stock units. The Company measures stock-based compensation cost at the grant date based on the estimated fair value of the award. The Company recognizes expense on awards with service-based vesting over the employee's requisite service period on a straight-line basis. In the third quarter of 2017, the Company issued performance stock units to certain employees related to the Spectrum Acquisition which were tied to the achievement of certain 2018 revenue and gross margin metrics and the passage of time. Additionally, in the first quarter of 2018 and again in the first quarter of 2019, the Company issued performance stock units to certain individuals which are tied to the achievement of certain annual revenue and return on invested capital metrics. The Company recognizes expense on performance-based awards over the vesting period based on the probability that the performance metrics will be achieved. The Company recognizes stock-based compensation expense for options that are ultimately expected to vest, and accordingly, such compensation expense has been adjusted for estimated forfeitures.

The fair value of share-based awards granted during the years ended December 31, 2019, 2018 and 2017 were calculated using the following estimated assumptions:

	For the Years Ended December 31,		
	2019	2018	2017
Expected term (in years)	5.5-6.5	5.5-7.5	6.1
Expected volatility (range)	45.14 – 50.87%	45.14 – 50.87%	51.48%
Risk-free interest rate	1.55 – 2.56%	2.63 – 2.96%	1.88 – 1.99%
Expected dividend yield	0%	0%	0%

Information regarding option activity for the year ended December 31, 2019 under the Plans is summarized below:

	Shares	Weighted average exercise price	Weighted-Average Remaining Contractual Term (in Years)	Aggregate Intrinsic Value (in Thousands)
Options outstanding at December 31, 2018	998,226	$27.54		
Granted	54,996	$64.14		
Exercised	(87,663)	$13.30		
Forfeited/expired/cancelled	(8,000)	$43.60		
Options outstanding at December 31, 2019	957,559	$30.81	6.69	$59,073
Options exercisable at December 31, 2019	513,577	$24.44	5.39	$34,954
Vested and expected to vest at December 31, 2019[1]	923,355		6.63	$57,235

(1) Represents the number of vested options as of December 31, 2019 plus the number of unvested options expected to vest as of December 31, 2019 based on the unvested outstanding options at December 31, 2019 adjusted for estimated forfeiture rates of 8% for awards granted to non-executive level employees and 3% for awards granted to executive level employees.

The aggregate intrinsic value in the table above represents the total pre-tax intrinsic value (the difference between the closing price of the common stock on December 31, 2019, the last business day of 2019, of $92.50 per share and the exercise price of each in-the-money option) that would have been received by the option holders had all option holders exercised their options on December 31, 2019. The aggregate intrinsic value of stock options exercised during the years ended December 31, 2019, 2018 and 2017 was $5.5 million, $5.3 million and $5.3 million, respectively.

The weighted average grant date fair value of options granted during the years ended December 31, 2019, 2018 and 2017 was $31.27, $18.90 and $16.94, respectively. The total fair value of stock options that vested during the years ended December 31, 2019, 2018 and 2017 was $3.1 million, $2.3 million and $2.2 million, respectively.

The fair value of stock units is calculated using the closing price of the Company's common stock on the date of grant. Information regarding stock unit activity, which includes activity for restricted stock units and performance stock units, for the year ended December 31, 2019 under the Plans is summarized below:

	Shares	Weighted-Average Remaining Contractual Term (in Years)	Aggregate Intrinsic Value (in Thousands)
Unvested at December 31, 2018	705,413		
Awarded	328,812		
Vested	(251,776)		
Forfeited/expired/cancelled	(47,465)		
Unvested at December 31, 2019	734,984	3.81	$67,986
Vested and expected to vest at December 31, 2019[1]	675,618	3.34	$62,495

(1) Represents the number of vested stock units as of December 31, 2019 plus the number of unvested stock units expected to vest as of December 31, 2019 based on the unvested outstanding stock units at December 31, 2019 adjusted for estimated forfeiture rates of 8% for awards granted to non-executive level employees and 3% for awards granted to executive level employees.

The aggregate intrinsic value in the table above represents the total pre-tax intrinsic value (equal to the closing price of the common stock on December 31, 2019, the last business day of 2019, of $92.50 per share, as stock units do not have an exercise price) that would have been received by the stock unit holders had all holders exercised on December 31, 2019. The aggregate intrinsic value of stock units vested during the years ended December 31, 2019, 2018 and 2017 was $17.5 million, $6.2 million and $4.0 million, respectively.

The weighted average grant date fair value of stock units granted during the years ended December 31, 2019, 2018 and 2017 was $49.68, $30.30 and $26.03, respectively. The total fair value of stock units that vested during the years ended December 31, 2019, 2018 and 2017 was $8.5 million, $4.6 million and $4.0 million, respectively.

As of December 31, 2019, there was $36.4 million of total unrecognized compensation cost related to unvested share-based awards. This cost is expected to be recognized over a weighted average remaining requisite service period of 4.09 years. The Company expects 1,688,497 unvested options and stock units to vest over the next five years.

10. Commitments and Contingencies

Licensing and Research Agreements

The Company licenses certain technologies that are, or may be, incorporated into its technology under several agreements and also has entered into several clinical research agreements which require the Company to fund certain research projects. Generally, the license agreements require the Company to pay annual maintenance fees and royalties on product sales once a product has been established using the technologies. Research and development expenses associated with license agreements were immaterial amounts for the years ended December 31, 2019, 2018 and 2017.

In September 2018, the Company entered into a collaboration agreement with Sartorius Stedim Biotech ("SSB"), a leading international supplier for the biopharmaceutical industry, to integrate our XCell ATF cell retention control technology into Sartorius's BIOSTAT® STR large-scale, single-use bioreactors to create novel perfusion-enabled bioreactors. As a result of this collaboration, end-users will stand to benefit from a single control system for 50L to 2,000L bioreactors used in perfusion cell culture applications. The single interface is designed to control cell growth, fluid management and cell retention in continuous and intensified bioprocessing and, ultimately, simplify the development and manufacture of biotechnological drugs under current good manufacturing practices.

In June 2018, the Company secured an agreement with Navigo for the exclusive co-development of multiple affinity ligands for which Repligen holds commercialization rights. The Company is manufacturing and has agreed to supply the first of these ligands, NGL-Impact™ A, exclusively to Purolite Life Sciences ("Purolite"), who will pair the Company's high-performance ligand with Purolite's agarose jetting base bead technology used in their Jetted A50 Protein A resin product. We also signed a long-term supply agreement with Purolite for NGL-Impact A and other potential additional affinity ligands that may advance from the Company's Navigo collaboration. The Navigo and Purolite agreements are supportive of the Company's strategy to secure and reinforce the Company's proteins business. The Company made payments to Navigo of $1.0 million and $2.4 million in the years ended December 31, 2019 and 2018, respectively, in connection with this program, which are recorded to research and development expenses in the Company's consolidated statements of comprehensive income.

Purchase Orders, Supply Agreements and Other Contractual Obligations

In the normal course of business, the Company has entered into purchase orders and other agreement with manufacturers, distributors and others. Outstanding obligations at December 31, 2019 of $39.1 million are expected to be completed within one year.

Legal Proceedings

From time to time, in the normal course of its operations, the Company is subject to litigation matters and claims relating to employee relations, business practices and patent infringement. Litigation can be expensive and disruptive to normal business operations. Moreover, the results of complex legal proceedings are difficult to predict and the Company's view of these matters may change in the future as the litigation and events related thereto unfold. The Company expenses legal fees as incurred. The Company records a provision for contingent losses when it is both probable that a liability has been incurred and the amount of the loss can be reasonably estimated. An unfavorable outcome to any legal matter, if material, could have an adverse effect on the Company's operations or its financial results.

11. Convertible Senior Notes

The carrying value of the Company's convertible senior notes is as follows:

	December 31,	
	2019	2018
	(Amounts in thousands)	
0.375% convertible senior notes due 2024:		
Principal amount	$287,500	$ —
Unamortized debt discount	(47,921)	—
Unamortized debt issuance costs	(6,812)	—
2.125% convertible senior notes due 2021:		
Principal amount	—	114,989
Unamortized debt discount	—	(9,781)
Unamortized debt issuance costs	—	(1,720)
Total convertible senior notes	$232,767	$103,488

0.375% Convertible Senior Notes due 2024

On July 19, 2019, the Company issued $287.5 million aggregate principal amount of 0.375% Convertible Senior Notes due 2024 ("2019 Notes"), which includes the underwriters' exercise in full of an option to purchase an additional $37.5 million aggregate principal amount of 2019 Notes (the "Notes Offering"). The net proceeds of the Notes Offering, after deducting underwriting discounts and commissions and other related offering expenses payable by the Company, were approximately $278.5 million.

The 2019 Notes are senior, unsecured obligations of the Company, and bear interest at a rate of 0.375% per year. Interest is payable semi-annually in arrears on January 15 and July 15 of each year, beginning on January 15, 2020. The 2019 Notes will mature on July 15, 2024, unless earlier repurchased or converted in accordance with their terms. The initial conversion rate for the 2019 Notes is 8.6749 shares of the Company's common stock per $1,000 principal amount of 2019 Notes (which is equivalent to an initial conversion price of approximately $115.28 per share). Prior to the close of business on the business day immediately preceding April 15, 2024, the 2019 Notes will be convertible at the option of the holders of 2019 Notes only upon the satisfaction of specified conditions and during certain periods. Thereafter until the close of business on the second scheduled trading day immediately preceding the maturity date, the 2019 Notes will be convertible at the options of the holders of 2019 Notes at any time regardless of these conditions. Conversion of the 2019 Notes will be settled in cash, shares of the Company's common stock or a combination thereof, at the Company's election. The 2019 Notes are not redeemable by the Company prior to maturity.

Holders of 2019 Notes may require the Company to repurchase their 2019 Notes upon the occurrence of a fundamental change prior to maturity at a repurchase price equal to 100% of the principal amount thereof, plus accrued and unpaid interest to, but excluding, the date of repurchase. In connection with certain corporate events, the Company will, under certain circumstances, increase the conversion rate for holders of 2019 Notes who elect to convert their 2019 Notes in connection with such corporate events.

As of December 31, 2019, the conditions allowing holders of the 2019 Notes to convert have not been met and therefore the 2019 Notes are not yet convertible and are recorded as a long-term liability in the Company's consolidated balance sheet at December 31, 2019. As of the date of this filing, no 2019 Notes were converted by the holders of such notes in the first quarter of 2020. In the event the closing price conditions are met in the first quarter of 2020 or a future fiscal quarter, the 2019 Notes will be convertible at a holder's option during the immediately following fiscal quarter.

The Company accounts for the 2019 Notes as separate liability and equity components. The Company determined the carrying amount of the liability component as the present value of its cash flows using a discount

rate of 4.5% based on comparative convertible transactions for similar companies. The proceeds allocated to the debt conversion feature were $52.1 million. This amount was calculated by deducting the carrying value of the liability component from the principal amount of the 2019 Notes as a whole. The difference represents a debt discount that is amortized to interest expense on the Company's consolidated statements of comprehensive income over the term of the 2019 Notes using the effective interest rate method. The Company will assess the equity classification of the cash conversion feature quarterly, and it is not remeasured as long as it continues to meet the conditions for equity classification.

The net carrying value of the equity component of the 2019 Notes is as follows (amounts in thousands):

	December 31, 2019
Proceeds allocated to the conversion feature	$ 52,062
Less: transaction costs allocated to the conversion feature	(1,621)
Less: deferred taxes	(11,371)
Net carrying value	$ 39,070

The Company allocates transaction costs related to the issuance of the 2019 Notes to the liability and equity components using the same proportions as the initial carrying value of the 2019 Notes. Transaction costs related to the liability component were $7.4 million and are being amortized to interest expense using the effective interest method over the term of the 2019 Notes. Transaction costs attributable to the equity component were $1.6 million and are netted with the equity component of the 2019 Notes in stockholders' equity of the Company's consolidated balance sheet at December 31, 2019.

Interest expense recognized on the 2019 Notes in 2019 was $0.5 million, $4.1 million and $0.6 million for the contractual coupon interest, the accretion of the debt discount and the amortization of the debt issuance costs, respectively. The effective interest rate on the 2019 Notes is 5.1%, which included the interest on the 2019 Notes, amortization of the debt discount and debt issuance costs. As of December 31, 2019, the carrying value of the 2019 Notes was $232.8 million and the fair value of the principal was $296.1 million. The fair value of the 2019 Notes was determined based on the most recent trade activity of the 2019 Notes as of December 31, 2019.

The 2019 Notes agreement contains customary terms and events of default. If an event of default (other than certain events of bankruptcy, insolvency or reorganization involving the Company) occurs and is continuing, the holders of at least 25% in aggregate principal amount of the outstanding 2019 Notes may declare 100% of the principal of, and any accrued and unpaid interest on, all of the 2019 Notes to be due and payable. Upon the occurrence of certain events of bankruptcy, insolvency or reorganization involving the Company, 100% of the principal of and accrued and unpaid interest, if any, on all of the 2019 Notes will become due and payable automatically. Notwithstanding the foregoing, the 2019 Notes provide that, to the extent the Company elects and for up to 270 days, the sole remedy for an event of default relating to certain failures by the Company to comply with certain reporting covenants consist exclusively of the right to receive additional interest on the 2019 Notes. The Company is not aware of any events of default, current events or market conditions that would allow holders to call or convert the 2019 Notes as of December 31, 2019.

Conversion of the 2.125% Convertible Senior Notes due 2021

The Company utilized a portion of the proceeds from the issuance of the 2019 Notes to settle its outstanding 2.125% Convertible Senior Notes due 2021 (the "2016 Notes") during the third quarter of 2019. On July 16, 2019, the Company entered into separate privately negotiated agreements with certain holders of the 2016 Notes to exchange an aggregate of $92.0 million principal aggregate amount of the 2016 Notes for shares of the Company's common stock, together with cash, in private placement transactions (the "Note Exchanges"). On July 19, 2019 and July 22, 2019, the Company used approximately $92.3 million (including $0.3 million of

accrued interest) and 1,850,155 shares of its common stock valued at $161.0 million to settle the Note Exchanges for total consideration of $253.3 million, of which $163.6 million was allocated to reacquiring the equity component of the 2016 Notes. The Company allocated the consideration transferred to the liability and equity components using the same proportions as the initial carrying value of the 2016 Notes. The transaction resulted in a loss on extinguishment of debt of $4.6 million in the Company's consolidated statements of comprehensive income in 2019.

On July 19, 2019, the Company issued a Notice of Redemption in respect of the 2016 Notes, which provided that, on September 23, 2019, the Company would redeem all 2016 Notes that had not been converted, repurchased or exchanged prior to such date at a redemption price in cash equal to 100% of the principal amount thereof plus accrued and unpaid interest. On September 23, 2019, the Company used $23.0 million and 466,045 shares of its common stock valued at $37.8 million to settle the remaining 2016 Notes for a total of $60.8 million, of which $38.3 million was allocated to reacquiring the equity component of the 2016 Notes. This transaction resulted in a loss on extinguishment of debt of $1.1 million recorded on the Company's consolidated statements of comprehensive income. The total loss in 2019 of $5.7 million represents the difference between the fair value of the liability component of the 2016 Notes and its related carrying value immediately before the exchange.

The fair value of the liability component was calculated using a discounted cash flow technique with an effective interest rate of 3.9%, representing the estimated nonconvertible debt borrowing rate with a maturity as of the measurement date consistent with the 2016 Notes maturity date of June 1, 2021. In addition, in accordance with this guidance, a portion of the fair value of the consideration transferred is allocated to the reacquisition of the equity component, which is the difference between the fair value of the consideration transferred and the fair value of the liability component immediately before the exchange. As a result, on a gross basis, $200.1 million was allocated to the reacquisition of the equity component of the original instrument, which is recorded net of deferred taxes within additional paid-in capital on the Company's consolidated balance sheet.

The cash conversion feature of the 2016 Notes required bifurcation from the 2016 Notes and was initially accounted for as an equity instrument classified to stockholders' equity, as the conversion feature was determined to be clearly and closely related to the Company's stock. Based on market data available for publicly traded, senior, unsecured corporate bonds issued by companies in the same industry and asset base and with similar maturity, the Company estimated the implied interest rate, assuming no conversion option. Assumptions used in the estimate represent what market participants would use in pricing the liability component, including market interest rates, credit standing, and yield curves, all of which are defined as Level 2 observable inputs. The estimated implied interest rate was applied to the 2016 Notes, which resulted in a fair value of the liability component of $96.3 million upon issuance, calculated as the present value of implied future payments based on the $115.0 million aggregate principal amount. The equity component of the 2016 Notes was recognized as a debt discount, recorded in additional paid-in capital, and represents the difference between the aggregate principal of the 2016 Notes and the fair value of the 2016 Notes without conversion option on their issuance date. The debt discount was amortized to interest expense using the effective interest method over five years, or the life of the 2016 Notes.

Interest expense recognized on the 2016 Notes in 2019 prior to conversion was $1.3 million, $2.4 million and $0.4 million for the contractual coupon interest, the accretion of the debt discount and the amortization of the debt issuance costs, respectively. The effective interest rate on the 2016 Notes was 6.6%, which included the interest on the 2016 Notes, amortization of the debt discount and debt issuance costs.

12. Accumulated Other Comprehensive Loss

Changes in accumulated other comprehensive loss consisted of the following for the years ended December 31, 2019 and 2018:

	Foreign Currency Translation Adjustment
Balance as of December 31, 2017	$ (6,363)
Other comprehensive loss	(5,530)
Balance as of December 31, 2018	(11,893)
Other comprehensive loss	(3,134)
Balance as of December 31, 2019	$(15,027)

13. Employee Benefit Plans

In the United States, the Repligen Corporation 401(k) Savings and Retirement Plan (the "401(k) Plan") is a qualified defined contribution plan in accordance with Section 401(k) of the Internal Revenue Code. All U.S. employees over the age of 21 are eligible to make pre-tax contributions up to a specified percentage of their compensation. Under the 401(k) Plan, the Company may, but is not obligated to match a portion of the employees' contributions up to a defined maximum. The match is calculated on a calendar year basis. The Company matched $1.0 million, $0.7 million and $0.5 million in the years ended December 31, 2019, 2018 and 2017, respectively.

In Sweden, the Company contributes to a government-mandated occupational pension plan that is a qualified defined contribution plan. All employees in Sweden are eligible for this pension plan. The Company pays premiums to a third-party occupational pension specialist who administers the pension plan. These premiums are based on various factors including each employee's age, salary, employment history and selected benefits in the pension plan. When an employee terminates or retires, these premium payments cease for that employee and the Company has no further pension-related obligations for that employee. For the years ended December 31, 2019, 2018 and 2017, the Company contributed $0.6 million, $0.6 million and $0.5 million, respectively, to the pension plan.

14. Related Party Transactions

In July 2017, in conjunction with the Spectrum Acquisition, the Board of Directors engaged one of the Company's independent directors to serve as the chairperson of the Spectrum Integration Committee. In this role, this Director worked directly with the Company's executive team on general integration strategy and focused on the integration of Spectrum's operations and commercial organization with the Company. The Company recorded $0.2 million of expense for the year ended December 31, 2017 related to this director's services.

Additionally, certain facilities leased by Spectrum are owned by Roy Eddleman, the former owner of Spectrum. As of December 31, 2019, Mr. Eddleman owned greater than 5% of the Company's outstanding shares and the Company considers him to be a related party. The lease amounts paid to this shareholder prior to the public offering were negotiated in connection with the Spectrum Acquisition. The Company incurred rent expense totaling $0.7 million for the year ended December 31, 2019 related to these leases.

As part of the Spectrum Acquisition, the Company was responsible for filing all tax returns for Spectrum for the period from January 1, 2017 through July 31, 2017, the day before the Spectrum Acquisition. The Company was responsible for collecting any tax refunds from federal and state authorities and remitting these refunds to the former shareholders of Spectrum, including the former owner of Spectrum who held more than 5% of the

Company's outstanding common stock prior to May 3, 2019. During 2018, the Company collected $1.7 million of these tax refunds, which the Company paid to the Spectrum shareholders during the fourth quarter of 2018, net of $0.2 million of expenses paid by the Company on behalf of Spectrum for tax preparation and other fees.

15. Selected Quarterly Financial Data (Unaudited)

The following table sets forth certain unaudited quarterly results of operations for 2019 and 2018. In the opinion of management, this information has been prepared on the same basis as the audited consolidated financial statements and all necessary adjustments, consisting only of normal recurring adjustments, have been included in the amounts stated below to present fairly the quarterly information when read in conjunction with the audited consolidated financial statements and notes thereto included elsewhere in this Form 10-K. The quarterly operating results are not necessarily indicative of future results of operations.

	For the Years Ended December 31, 2019			
	Q1	Q2	Q3	Q4
	(Amounts in thousands, except per share data)			
Revenue	$60,634	$70,692	$69,445	$69,474
Gross profit	33,789	39,984	38,020	39,353
Operating expenses	49,463	59,638	61,481	63,580
Net income	8,053	8,095	1,659	3,604
Earnings per share:				
Basic	$ 0.18	$ 0.17	$ 0.03	$ 0.07
Diluted	$ 0.17	$ 0.17	$ 0.03	$ 0.07

	For the Years Ended December 31, 2018			
	Q1	Q2	Q3	Q4
	(Amounts in thousands, except per share data)			
Revenue	$44,830	$47,731	$49,529	$51,942
Gross profit	25,162	26,643	27,346	28,350
Operating expenses	38,854	43,458	41,643	44,089
Net income	3,448	2,738	4,794	5,638
Earnings per share:				
Basic	$ 0.08	$ 0.06	$ 0.11	$ 0.13
Diluted	$ 0.08	$ 0.06	$ 0.10	$ 0.12

Board of Directors

Karen A. Dawes
Chairperson
President, Knowledgeable Decisions, LLC

Nicolas M. Barthelemy
Former President and
Chief Executive Officer,
bioTheranostics

Tony J. Hunt
President and Chief Executive Officer,
Repligen Corporation

Rohin Mhatre, Ph.D.
Senior Vice President,
Product and Technology,
Biogen Inc.

Glenn P. Muir
Former Chief Financial Officer
and Executive Vice President,
Hologic, Inc.

Thomas F. Ryan, Jr.
Former President and
Chief Operating Officer,
American Stock Exchange

Investor Information

Copies of our annual reports on Form 10-K, proxy statements, quarterly reports on Form 10-Q and current reports on Form 8-K are available to shareholders upon request without charge.

Please visit our website at www.repligen.com or direct requests to:

Repligen Corporation
41 Seyon Street, Building #1, Suite 100
Waltham, MA 02453
ATTN: Investor Relations
Phone: 781.250.0111
investors@repligen.com

Executive Management

Executive Officers:

Tony J. Hunt
President and Chief Executive Officer

Jon K. Snodgres
Chief Financial Officer

Ralf Kuriyel
Senior Vice President,
Research & Development

Senior Management:

Operations -

Jim Bylund
Executive Vice President,
Global Operations and IT

Steve Curran
Vice President, Global Operations

Maria Nieradka
Vice President, Business Operations

Commercial -

Stephen Tingley
Vice President, Sales

Businesses -

Christine Gebski
Senior Vice President,
Cell Culture/Chromatography

Craig Harrison
Senior Vice President, Process Analytics

Gautam Choudhary
Vice President, Systems and Automation

Vikas Gupta
Vice President, Downstream Processing
and Gene Therapy

Anthony MacDonald
Senior Vice President,
Ultrafiltration/Diafiltration

Human Resources -

Ken Elmer
Global Head, Human Resources

Market for Repligen Stock

NASDAQ Global Select Market: RGEN

Transfer Agent and Registrar

American Stock Transfer
& Trust Company, LLC
59 Maiden Lane, Plaza Level
New York, NY 10038
Phone: 877.777.0800, option 1
info@amstock.com

The Transfer Agent is responsible for handling shareholder questions regarding lost certificates, address changes and change of ownership or name in which shares are held.

Corporate Counsel

Goodwin Procter LLP
100 Northern Avenue
Boston, MA 02210

Independent Accountants

Ernst & Young LLP
200 Clarendon Street
Boston, MA 02116

Annual Meeting

The Annual Meeting of Shareholders will be held on Wednesday, May 13, 2020, 8:00 a.m. EDT

Location
Our 2020 Annual Meeting will be held online (only) at http://www.virtualshareholdermeeting.com/RGEN2020

You can vote your shares if you were a shareholder of record at the close of business on April 1, 2020 (the "Record Date").

REPLIGEN CORPORATION
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