OTL

A HALF CENTURY OF PIONEERING INNOVATION

STANFORD OFFICE OF TECHNOLOGY LICENSING

ANNUAL REPORT FY 2020

“What is now proved
was once only imagined.”

—WILLIAM BLAKE
19TH-CENTURY ENGLISH POET

NUMBER OF TECHNOLOGIES THAT HAD > $100K IN INCOME FOR AT LEAST ONE FISCAL YEAR

575

NUMBER OF TECHNOLOGIES THAT HAD > $1M IN INCOME FOR AT LEAST ONE FISCAL YEAR

103

11,407

INVENTORS

415

STARTUPS

13,699

CUMULATIVE TECHNOLOGIES

50 YEARS @ A GLANCE

2,539

REVENUE-GENERATING INVENTIONS

5,261

CUMULATIVE LICENSES SIGNED

TOP 5

REVENUE-GENERATING INVENTIONS

- **FUNCTIONAL ANTIBODIES**
- **PAGERANK ALGORITHM**
- **RECOMBINANT DNA**
- **CD47 CANCER IMMUNOTHERAPY**
- **TRANSCRIPTION-MEDIATED AMPLIFICATION**

4,832

CUMULATIVE U.S. PATENTS ISSUED

21,722

CUMULATIVE INDUSTRY RESEARCH AGREEMENTS

5,440

CUMULATIVE SPONSORED RESEARCH AGREEMENTS

$2,109,000,000

CUMULATIVE LICENSING REVENUE

REFLECTIONS ON A MILESTONE

IN THEIR OWN WORDS

To understand OTL's half century of pioneering innovation, we interviewed more than a dozen Stanford executives, inventors, and staff past and present. Sitting down with a few of the people who've shaped OTL's 50-year history is a once in a generation opportunity. What emerges are memories of discovery and disruption that, together, begin to build a much larger story of Stanford's mission to transform its research outcomes into useful commercial products and services.

OTL's role in that story is fundamentally about people — like the tale of the licensing associate who took a chance on a grad student's vision of the web, and the young researcher taking aim at rare pediatric cancer. Many of their reflections are featured throughout the pages of this 50th Anniversary Annual Report. One common thread is that innovation takes a village. Another is collaboration — how OTL works synergistically with the many translational research and entrepreneurship programs on campus to enable successful commercialization.

In the words of Prof. **Jennifer Dionne**, Senior Associate Vice Provost for Shared Facilities, "OTL is not just a place to file a patent, but a vibrant and vital community for inventors."

Foundation

"My fundamental philosophy has always been to plant as many seeds as possible."

—KATHARINE KU, EXECUTIVE DIRECTOR OF OTL FROM 1991 TO 2018

"I just have to get this off my chest," says **Kevin Grimes**, co-director of Stanford's SPARK program. "I have been traveling around the world to a lot of universities that are trying to get translational research off the ground. Stanford OTL is the envy of every university on the planet."

Today, OTL manages and markets more than 500 new invention disclosures per year from investigators across campus. But the pace and scale of invention was not always like this. When maverick Stanford administrator **Niels Reimers** and office manager **Sally Hines** launched the OTL pilot in the late 1960s, the technology development and commercialization landscape was unrecognizable.

At that time, Stanford's patent management was contracted out to a corporation in New York that generated just $5,000 in royalties over 13 years. Reimers' in-house program bested those returns more than tenfold in its first year. OTL was swiftly made official in 1970 and would become the model for licensing offices around the world.

"They said 'there's no career path for you,'" laughs Reimers, who retired from Stanford in 1991.

Testifying before Congress, Reimers was Stanford's voice in championing the Bayh-Dole Act, the 1980 bipartisan legislation that undergirds modern tech transfer. **Joe Allen**, who helped chart the law's tortuous passage as a staff member for Sen. Birch Bayh, lauds Reimers' vision some 40 years on. Allen notes that at the time of those Senate hearings, an estimated 28,000 inventions had "piled up" in the federal agencies, and less than 5 percent were ever licensed.

"I think that the mission of U.S. universities is very well served by the Bayh-Dole legislation," says **Ann Arvin**, former Vice Provost and Dean of Research at Stanford. "Faculty and students and research staff who create new knowledge need a path to move that knowledge out of the university to industry for practical applications and that is very largely through offices of technology licensing."

Tech transfer continued to evolve significantly in the years following Bayh-Dole. At a critical juncture, **Katharine Ku**, Reimers' successor and longtime director of OTL, helped craft the guidelines that shape university licensing practices to this day.

Those guidelines, known as the "Nine Points to Consider in Licensing University Technology," are a set of widely adopted principles that encourage creative solutions to complex problems that may arise when universities license technologies for society's benefit.

"The Nine Points are a pledge of allegiance that we as universities transfer technology for the public good," Ku says.

Innovation

"You can't just throw technology over the wall. If you look at the long history of Stanford technology transfer, dating back to Hewlett and Packard, it's all about people. And I don't think that's going away."

**—JOHN HENNESSY,
STANFORD PRESIDENT FROM 2000 TO 2016**

Ask an OTL staff member about memorable stories and they chronicle breakthroughs like recombinant DNA, functional antibodies, interactive data visualization software, solid-state batteries, and new frontiers in medical devices and medical imaging.

After thirty years and hundreds of cases, **Luis Mejia** still recalls meeting Larry Page in the lobby of OTL. Page, a graduate student, had come with a novel algorithm for ranking web pages on the emergent internet. Page looked to license his complex solution to any extant tech company. Mejia, a seasoned licensing associate, started working his contacts.

The rejection was universal. Just as Page and colleague Sergey Brin prepared to embark on their own venture, one company called back seeking a non-exclusive license. Mejia declined.

"I knew it would damage the possibility of Larry and Sergey's startup. I decided, okay, it's not about the money. It's really about doing the right thing for the technology."

Everyone in the office watched what happened next.

"How Google evolved — we planted one seed and they just grew. Totally crazy," says **Linda Chao**, a former OTL senior licensing associate now at MIT, who finalized and managed the license after Mejia had negotiated the financial arrangements with Google.

But Google was not OTL's first nor unlikeliest triumph.

It was 1970, and **John Chowning**, a composer in the music department with six years of moonlight research in computer sound synthesis at the Stanford Artificial Intelligence Laboratory (SAIL), reached out to the newly created OTL with an extraordinary acoustic discovery. His invention, frequency modulation (FM) synthesis, enabled the sound of 'real' instruments to be replicated digitally.

Turned down by top instrument makers, the tenacity of OTL staff led to a collaboration with Yamaha Corporation, and the advent of digital sound as we know it — from video game consoles to cell phones.

"I never wanted to be an inventor," says Chowning. "I'm a discoverer. One musicologist told me, 'what you're doing is the dehumanization of music.' And I said, maybe it's the humanization of computers."

The storied collaboration illustrates what **Sara Nakashima**, a former senior licensing associate and now special projects associate at OTL, describes as customer service.

"With OTL, it's about what's best for the technology," Nakashima says. "We have a very collaborative approach to working with the researchers. Customer service is really key. The relationship with the inventors is the essential thing."

Mona Wan, OTL's associate director of licensing, adds that Stanford's key differentiator is its risk-taking culture. "Failure isn't an issue because the mindset is that you can still be successful even if you fail several times in a row."

Challenges

"Going forward, I would like to see OTL play a more formative role in Stanford Research."

—KATHRYN ANN MOLER, DEAN OF RESEARCH

In April 2020, a trio of university licensing offices — Stanford, MIT and Harvard — launched an unprecedented technology access framework to speed the deployment of COVID-19 solutions.

A year later, the rise and evolution of the pandemic has inspired many in the scientific community to reflect on lessons learned.

"I am hoping that this coronavirus experience will lead to more open collaboration and sharing of data," says **Sandy Shotwell**, a former OTL licensing associate who now leads a drug discovery company. "I'm not sure how that will be accomplished given the incentives in the field, but I'm hoping this year will teach us that."

Beyond COVID-19, tomorrow's pressing issues are already upon us, observes **Glennia Campbell**, director of OTL's Industrial Contracts Office.

"What we're seeing is an upswing in big data and research on data," Campbell says. "Particularly in AI and machine learning, they need data in order to train algorithms. How we view data as an asset and how we protect privacy is a big question that is evolving right now."

The challenges aren't all technological, notes Director **Karin Immergluck**. For OTL to fulfill its mission to transfer knowledge for the public good, we must make an effort to engage all faculty, including women and people of color, to help ensure that their novel ideas having commercial potential are developed and given the visibility they deserve.

"We need to make sure that we are proactively reaching out to underrepresented populations to help them realize that, yes, you too can be an entrepreneur," Immergluck says.

"There is a shift happening across academia among women thinking of themselves beyond just basic researchers. I think it's not just the research mentality, but how universities are working with corporations," says **Kirsten Leute**, a former OTL associate director of licensing and now at Osage University Partners, a venture capital firm.

"Those ivory towers are no longer. They can't be, because it stifles how innovation progresses."

Opportunities

"We need to keep evolving with the changing global landscape."

**—KARIN IMMERGLUCK,
EXECUTIVE DIRECTOR OF OTL**

"Our faculty members might target their research more successfully if they refined their understanding of what it means to have transferable technology," says Stanford's Dean of Research **Kathryn Ann Moler**. "In the future, I would like to see OTL expand their activities to educate our research community about entrepreneurship, market requirements, and industrial requirements."

Daria Mochly-Rosen, director of Stanford's SPARK translational research program, is one of OTL's close partners. The majority of SPARK projects address chronically neglected areas including child and maternal health, global health, and orphan diseases.

"OTL is open to out-of-the-box thinking," Mochly-Rosen says. "It will continue to lead the path for other tech transfer offices."

"Big problems call for science," notes Arvin, the former dean of research who worked with former Stanford President Hennessy to shape the university's interdisciplinary culture. "We know that discovery science is not what it used to be. Stanford researchers have to have access to much more sophisticated technologies, instrumentation, and large-scale computing to sustain the creation of new knowledge."

Brian Bartholemuez, executive director of Innovation Transfer for the TomKat Center, agrees that Stanford will continue to rise to the challenges, not only because it is equipped with those resources, but because it has the "the tribal lore of how to do it. Think of the waves of innovation that have swept through the Valley. There is a lot of retained knowledge that's passed down to successive generations."

And whether it's CRISPR gene editing or artificial intelligence, the next waves are arriving now.

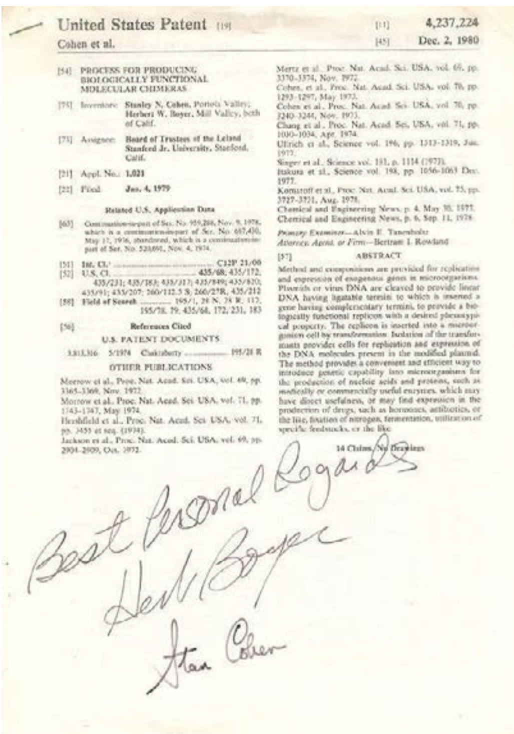
John Hennessy, former president of Stanford and now Alphabet Chairman, says: "These revolutionary platforms are moving at the same rates as the semiconductor industry in the Moore's law era. Figuring out how we build on that and ensure that it's delivered to society is going to be our key. We owe future generations the ability to ensure that they can get out their innovations and spread [them] to society."

It is precisely that vision — of honoring the past while embracing the 'next 50' and beyond — that is shared by Immergluck.

"Part of my job is to maintain that iconic status as one of the leading tech transfer offices of the world," she says. "But at the same time . . . we need to keep evolving with the changing global landscape."

1970s BEGINNINGS

The 1970s witnessed the beginning of modern computing, the rise of fiber optics technology, integrated circuits and semiconductor lasers. Major advances were taking place in medicine, including computerized axial tomography (CAT), monoclonal antibody technology, and immunotherapy. The first complete DNA genome was sequenced in 1977, when researchers identified the genetic structure of a type of virus.



United States Patent [19]
Cohen et al.
[11] 4,237,224
[45] Dec. 2, 1980

[54] PROCESS FOR PRODUCING BIOLOGICALLY FUNCTIONAL MOLECULAR CHIMERAS

[75] Inventors: Stanley N. Cohen, Portola Valley; Herbert W. Boyer, Mill Valley, both of Calif.

[73] Assignee: Board of Trustees of the Leland Stanford Jr. University, Stanford, Calif.

[21] Appl. No.: 1,021

[22] Filed: Jan. 4, 1979

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 959,288, Nov. 9, 1978, which is a continuation-in-part of Ser. No. 687,430, May 17, 1976, abandoned, which is a continuation-in-part of Ser. No. 520,691, Nov. 4, 1974.

[51] Int. Cl. ... C12P 21/00
[52] U.S. Cl. ... 435/68; 435/172; 435/231; 435/183; 435/317; 435/849; 435/820; 435/91; 435/207; 260/112.5 S; 260/27R; 435/212
[58] Field of Search ... 195/1, 28 N, 78 R, 112, 195/78, 79; 435/68, 172, 231, 183

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Chemical and Engineering News, p. 4, May 30, 1977.
Chemical and Engineering News, p. 6, Sep. 11, 1978.

Primary Examiner—Alvin E. Tanenholtz
Attorney, Agent, or Firm—Bertram I. Rowland

[57] ABSTRACT

Method and compositions are provided for replication and expression of exogenous genes in microorganisms. Plasmids or virus DNA are cleaved to provide linear DNA having ligatable termini to which is inserted a gene having complementary termini, to provide a biologically functional replicon with a desired phenotypical property. The replicon is inserted into a microorganism cell by transformation. Isolation of the transformants provides cells for replication and expression of the DNA molecules present in the modified plasmid. The method provides a convenient and efficient way to introduce genetic capability into microorganisms for the production of nucleic acids and proteins, such as medically or commercially useful enzymes, which may have direct usefulness, or may find expression in the production of drugs, such as hormones, antibiotics, or the like, fixation of nitrogen, fermentation, utilization of specific feedstocks, or the like.

14 Claims, No Drawings

The recombinant DNA patent, autographed by Stanley Cohen and Herbert Boyer for Niels Reimers

Recombinant DNA Lays the Foundation for the Biotech Industry

Prof. **Stanley Cohen** and Prof. Herbert Boyer (UC San Francisco) first conceived of a way to "clone" DNA, the substance that contains an organism's complete genetic information, while attending a conference in Honolulu, Hawaii in 1972. Chatting at a delicatessen on Waikiki Beach, the two researchers postulated that with Boyer's restriction enzymes and Cohen's plasmid technology, it might be possible to insert foreign DNA into a plasmid, insert that plasmid into a living organism, then induce that organism to replicate and produce the foreign DNA. In just four months Cohen and Boyer together successfully cloned their first piece of DNA.

The discovery of recombinant DNA technology set the stage for modern genetics and the biotech industry. The first commercial recombinant DNA product, engineered by Genentech, was human insulin for diabetics. Vaccines for COVID-19, influenza, papilloma virus and hepatitis B, along with human growth hormones, monoclonal antibodies, and CRISPR are among the many technologies founded on recombinant DNA.

> "People tend to think that once you have an invention, its value will be readily perceived by aggressive companies and worth millions. That's so far from the truth."
>
> —NIELS REIMERS
> 1975 STANFORD CAMPUS REPORT

1970

Niels Reimers formally establishes the Office of Technology Licensing.

1971

Stanford Research Institute (SRI) separates from Stanford University.

1972

Profs. John Farquhar and Peter Wood lead the first large investigation that shows lowering cholesterol levels prevents heart disease.

1973

Prof. Paul Berg successfully combines the DNA of two different organisms.

1974

Prof. Bradford Parkinson leads the development of Global Positioning System (GPS).

Prof. William S. Robinson isolates the genetic blueprint of a virus that causes Hepatitis B.

Prof. John Chowning playing the Yamaha DX-7

FM Sound Synthesis and Digital Music

Prof. **John Chowning** pioneered algorithms for frequency modulation (FM) sound synthesis beginning in 1967. His invention disclosure for "location and movement of sound" was one of the first cases handled by OTL after the office was established in 1970. In 1974, Chowning founded the Center for Computer Research in Music and Acoustics (CCRMA) at Stanford, which remains one of the leading centers for computer music and related research. Yamaha licensed his discoveries in 1975, producing the most successful line of digital synthesis engines ever brought to market. FM synthesis sounds would eventually figure prominently in nearly every pop music hit of the 1980s, such as the work of Madonna and Phil Collins. FM sound synthesis was OTL's first 'home run' and was for many years one of the university's top revenue- producing licenses.

The Litton Project

Prof. **H. John Shaw**'s fiber optics research in the late 1970s led to The Litton Project. This program produced fiber optic technology, components and devices that have been adopted by laboratories and companies worldwide.

Optimization Software

Beginning in 1975, several software programs were developed for solving large-scale optimization problems by scientists **Philip Gill, Walter Murray, Bruce Murtagh, Michael Saunders**, and **Margaret Wright** in Stanford's Department of Operations Research. Programs such as MINOS™, NPSOL™, and SNOPT™ have been and continue to be licensed for use in optimizing radiation treatment of brain tumors, modeling cellular metabolism in the human body, energy and greenhouse gas research, aerospace applications, and designing New Zealand's winning America's Cup yacht (1990), among many other things.

Birth of Flow Cytometry

Prof. **Leonard Herzenberg** invented the fluorescence-activated cell sorter (FACS). Also known as flow cytometry, the technology enables various types of cells to be easily identified for further study, revolutionizing immunology and enabling stem cell research.

Prof. Leonard Herzenberg in his lab

Prof. Vinton Cerf and students publish the Transmission Control Protocol, a key component of the modern internet.

Prof. Paul Flory receives the Nobel Prize in Chemistry.

1976

Prof. Burton Richter receives the Nobel Prize in Physics.

Prof. Martin Hellman, with PhD candidates Whitfield Diffie and Ralph Merkle, invents public key cryptography, a tool in use today to secure trillions of financial transactions daily.

1978

NIH grants Stanford licensing rights for Recombinant DNA technique.

1979

Prof. Avram Goldstein discovers dynorphin, a brain chemical 200 times more powerful than morphine.

1980s COMING OF AGE

The mass-market availability of personal computers and mobile phones with access to the Global Positioning System (GPS) had a dramatic effect on every aspect of society. A new tool for measuring DNA called polymerase chain reaction (PCR) would revolutionize molecular biology, medical diagnostics, and even ecology as it helped scientists better understand Earth's genetic biodiversity. Magnetic resonance imaging (MRI) was introduced, providing a way to generate images of soft tissue without the use of radiation.

"I have worked with OTL on numerous inventions during my career at Stanford and have valued their expertise and friendly support throughout this time."

—PROF. MICHELLE CALOS

Fiber Optic Amplifier

In the early 1980s, Prof. **Michel Digonnet** invented the fiber optic amplifier, a component that amplifies a light signal inside a fiber. The fiber optic amplifier played a crucial role in the telecommunications revolution of the mid-1990s, including development of the high-speed Internet. During the eighties and beyond, Prof. Digonnet disclosed dozens of photonics and fiber optics inventions to OTL.

Fluorescent Phycobiliproteins

Phycobiliproteins are highly fluorescent proteins that occur naturally in certain types of bacteria and algae. Profs. **Lubert Stryer** and Alexander Glazer (UC Berkeley) with postdoc fellow **Vernon Oi** developed Fluorescent Tandem Phycobiliprotein Conjugates, a powerful class of reagents for sorting and identifying cells, including cancer cells. Multidimensional fluorescence analysis has enabled a better understanding of interactive cellular systems, and is still used extensively by biotech researchers all over the world.

Selective Amplification of Target Polynucleotide Sequences

Prof. **John Boothroyd** and postdoc fellows **Larry Burg** and **Philippe Pouletty** developed an alternative to Polymerase Chain Reaction for multiplying the number of copies of a target polynucleotide sequence. This method of nucleic acid testing is rapid, highly specific and extremely sensitive, with the added benefit that the amplification is all performed at 37°C. The technology is currently being used to detect Zika virus and SARS-CoV-2.

1981

Prof. Ronald Levy develops mAb therapy for cancer.

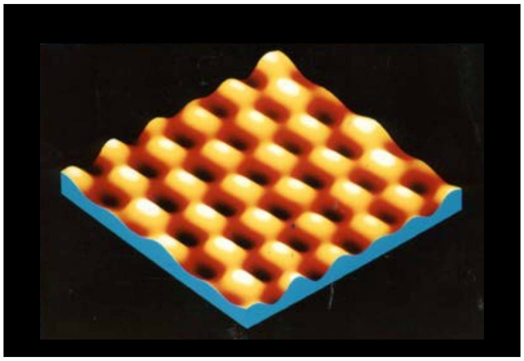
Prof. Bruce Reitz performs the first heart-lung transplant in the U.S.

1982

Sun Microsystems is founded by electrical engineering doctoral student Andreas Bechtolsheim, along with Scott McNealy, Vinod Khosla, Bill Joy.

Silicon Graphics is founded by Prof. James Clark.

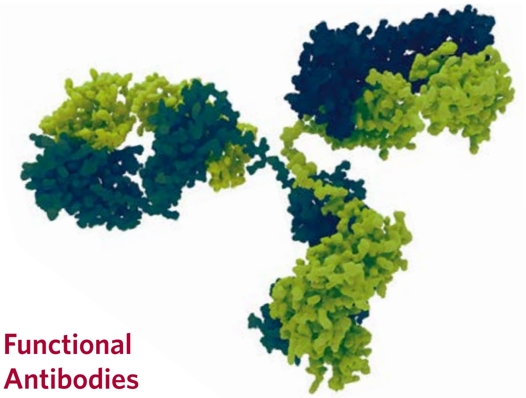
Knowledge Systems Labs is founded by Profs. Ed Feigenbaum and Bruce Buchanan.



Atoms on the surface of boron nitride, 2.5 Å apart

Atomic Force Microscopy

In the mid-1980s, Prof. **Calvin Quate** and IBM collaborators Gerd Binnig and Christoph Gerber introduced the atomic force microscope (AFM). AFM transformed the nanotech industry and nanofabrication through its ability to deliver 3D images on the order of fractions of a nanometer, more detailed than the best optical microscopes of the time, all while retaining the gentleness of the acoustic microscope.



Functional Antibodies

Prof. **Leonard Herzenberg** and senior research associate **Vernon Oi**, in collaboration with Prof. Sherie Morrison (Columbia), invented a technique for producing functional antibodies. Their patent for functional antibody technology is one of OTL's top royalty generators and the basis of medicines for rheumatoid arthritis, Crohn's disease, respiratory illness in young children, and clot prevention.

MIPS and A New Golden Age for Microprocessors

Prof. and past president **John Hennessy** and Prof. David Patterson, his collaborator at UC Berkeley, pioneered the reduced instruction set computer (RISC), implementing the design principle of simplified instructions and providing a systematically quantitative approach in evaluating computer architectures. Additionally, Hennessy initiated the Microprocessor without Interlocked Pipelined Stages (MIPS) collaboration project. Inspired by ideas coming out of the project and the promising commercial potential of RISC, Hennessy, along with grad student **Chris Rowen** and Stanford alum **Skip Stritter**, co-founded MIPS Computer Systems in 1984. A fabless semiconductor design company, it was one of the first startups developing RISC microprocessors based on the MIPS architecture. Most of the microprocessors powering mobile and IoT applications are built on these faster, more energy-efficient approaches. As such, it occupies an important place in the history of Silicon Valley. Both Hennessy and Patterson received the Turing Award for their enduring impact on the microprocessor industry.

Stanford computer scientists John Shott, John Hennessy and James D. Meindl (left to right) brainstorm about the MIPS project

1983

Alumna Sally Ride becomes the first American woman in space on the Space Shuttle Challenger.

1984

Prof. Mark Davis publishes seven papers in *Nature* over the course of the year characterizing the first T-cell receptor genes.

Alumni Leonard Bosack and Sandy Lerner co-found Cisco Systems.

1988

Prof. Irving Weissman and colleagues identify a panel of antibodies that can be used to isolate blood-forming stem cells from mice, a feat that had never been achieved before.

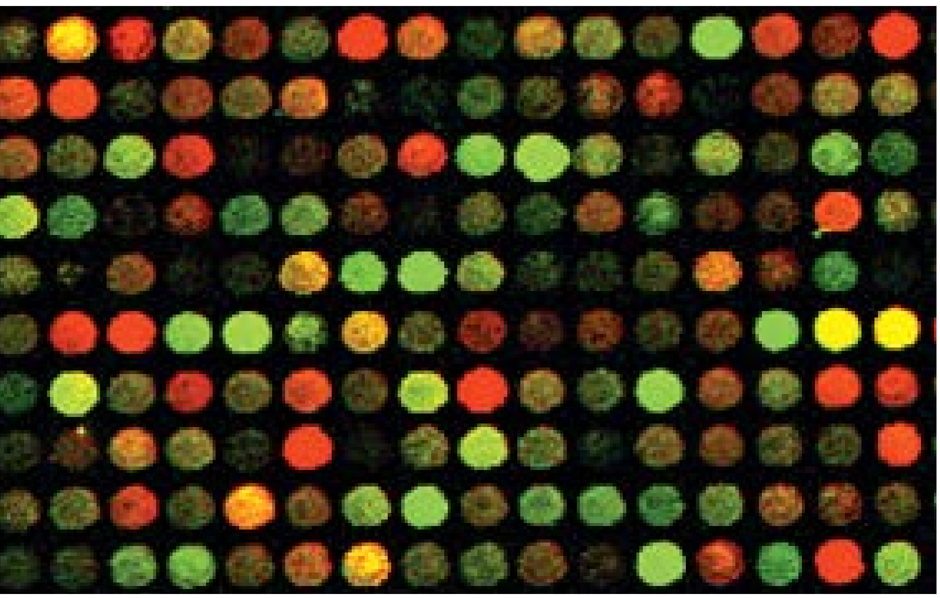
1989

Prof. Eugene Butcher discovers a receptor that guides white blood cells into the peripheral lymph nodes.

1990s

GAME CHANGERS

As the twentieth century drew to a close, transformative technologies continued to proliferate. The introduction of the World Wide Web, easily-accessible web browsers and Internet search engines gave people immediate access to more information. The world was becoming more fast-paced and interconnected. The Hubble Telescope, launched in 1990, revolutionized astronomy.



The colors on the microarray show which genes in a sample are active

DNA Microarray

Developed by Prof. **Patrick O. Brown**, DNA microarray technology is a tool used for large-scale studies of gene expression. In 1997, Brown and his colleagues published the first whole-genome microarray study of gene expression by placing the whole yeast genome on a microarray. Shortly after developing the technology, the Brown lab shared the blueprints and protocols on the Web so that other academic researchers could use it internally for their own research. These robotic devices have now become standard equipment in life science labs throughout the world.

Advancing High Speed Internet Access

In the early 1990s, fiber optic cable was the industry standard for transmitting data; but there was growing consumer demand for bandwidth. During this time, Prof. **John Cioffi** and graduate students **Jacky Chow, Peter Chow, Minnie Ho,** and **Huiling Lou** were developing technology related to discrete multi-tone modulation that would then be used in DSL, ADSL, VDSL, G.fast, and G.mgfast. The discovery's continued use has led to data rates as high as 10 Gbps on a twisted pair. The VDSL patent has been used globally in high-speed internet access, including all vectored DSLs, most Wi-Fi, and 4G/5G wireless base stations.

1991

Prof. Martin Fisher and entrepreneur Nick Moon found ApproTEC (now KickStart International) to lift African farmers out of poverty with inexpensive agricultural equipment.

1992

Alumna Mae Jemison orbits the Earth for nearly eight days on the Space Shuttle Endeavour.

1994

Prof. Ron Davis becomes Director of the Stanford DNA Sequencing and Technology Center.

Student inventors of the PageRank Algorithm Larry Page (left) and Sergey Brin (right)

PageRank Algorithm

Larry Page and **Sergey Brin** were graduate students in Stanford's Department of Computer Science in the mid-1990s conducting research on World Wide Web search methodologies. Search technologies at the time were ineffective and poor at producing reasonable results. That problem was only getting worse because the number of pages on the WWW was growing exponentially. Larry and Sergey's research at Stanford led to an invention entitled "Improved Text Searching in Hypertext Systems." OTL filed a patent application on the invention and, with Larry and Sergey's help, attempted to find a licensee to commercialize the invention. After getting lukewarm responses or no interest from existing search companies, Larry and Sergey approached OTL about licensing a startup that they would co-found. Because it was the right thing to do for the technology, OTL green-lighted the exclusive license to their startup, Google. As a result, Larry and Sergey ended up creating something that has become an indispensable part of our lives.

> **"Most of these devices have become really important . . . some right away, while others had to wait for their field to catch up with them."**
>
> **—PROF. H. JOHN SHAW 1997 OTL BRAINSTORM NEWSLETTER**

Industrial Contracts Office Established

Before ICO came into existence, all sponsored research and related agreements were handled by Stanford's Sponsored Projects Office (SPO), with some help from OTL on heavy-duty intellectual property issues. However, in the mid-nineties, while Kathy Ku was Director of OTL and acting director for SPO, she noticed a significant growth in industry-related issues. Thus in 1998, ICO was born to specialize in industry contracts, with Glennia Campbell, ICO's current director, as the first attorney hired. ICO grew from one attorney to its current complement of 11 full-time employees handling a wide range of industry and non-industry related contracts.

OTL Equity

OTL's first significant equity return occurred in 1994 upon the acquisition of Risk Management Solutions. The equity was received as partial consideration for a license to software developed at Stanford for assessing risk from natural disasters. In that same year, Stanford instituted an equity policy that allowed OTL to take equity as partial consideration for a license, upon approval, with the entire institutional share of the proceeds going to a Research and Fellowship fund administered by the Dean of Research. The financial success of that policy has led to the support of graduate students and research at Stanford, yet another way that OTL contributes to the overall mission of Stanford.

1996

Prof. Stan Cohen and UC Berkeley Prof. Herbert Boyer receive the Lemelson-MIT prize.

Prof. Douglas Osheroff receives the Nobel Prize in Physics.

1997

Prof. Steven Chu receives the Nobel Prize in Physics.

Alumnus Reed Hastings and entrepreneur Marc Randolph co-found Netflix.

2000s RAPID GROWTH

Major advances in battery research would lead to the introduction of hybrid vehicles. Mass production of photovoltaic systems for generating electric power steered a path toward reducing greenhouse gas emissions. The popularity of smartphones and text messaging surged. Robotics continued to develop, especially telerobotics in surgery. Tissues and organs created entirely by 3-D printing were being successfully implanted in humans. The Human Genome Project, initiated in 1990, was completed in April 2003. During the 2000s the FDA approved 244 new drugs.

Prof. Sanjiv Sam Gambhir, global leader in advancing techniques for molecular imaging and early cancer detection

Molecular Imaging

Under Prof. **Sanjiv Gambhir,** the Molecular Imaging Program at Stanford (MIPS) was established as an interdisciplinary program to bring together scientists and physicians who share a common interest in developing state-of-the-art imaging technology and molecular imaging assays for studying intact biological systems.

Help for Celiac Disease

From 2001 to 2007, Prof. **Chaitan Khosla** and colleagues researched an enzyme that can inactivate the toxic components of gluten in the digestive system, resulting in several inventions for treating Celiac Disease. The technology was licensed, giving patients access to a treatment alternative that didn't entail severe dietary restrictions.

Advances in Software Technology

In the early 2000s, Prof. **Chris Stolte** and colleagues developed software that allowed for the interactive visualization of data in large databases, resulting in the Polaris software platform. Stolte, along with Stanford Business School alum **Christian Chabot** and Prof. **Pat Hanrahan**, co-founded Tableau Software in 2003 (acquired by Salesforce in 2019). Prof. **Dawson Engler** and colleagues developed a method for detecting errors in complicated software systems, and in 2002 he co-founded Coverity, Inc. (acquired by Synopsys in 2014.) Taken together, these inventions became some of OTL's top revenue generators during the 2000s and beyond.

2000

Prof. Roger Kornberg describes the structure of the RNA polymerase protein, unlocking an important piece of the puzzle on how information is transferred from genes to proteins.

2001

Prof. K. Barry Sharpless receives the Nobel Prize in Chemistry.

2002

Prof. Mark Kay develops RNA inhibition technique for switching off genes in mice.

2003

The Clark Center opens, providing a home for many faculty members affiliated with the Bio-X program and becoming a nucleus for scientific and technological collaborations across the Stanford community.

Prof. Roeland Nusse isolates a group of proteins called Wnts that help keep stem cells in their youthful state.

Profs. Amato Giaccia and Jennifer Cochran

Targeted Therapy for Ovarian Cancer

Researchers in Prof. **Jennifer Cochran**'s lab and Prof. **Amato Giaccia's** lab collaborated in engineering a novel protein therapeutic to inhibit tumor growth and metastasis, which is the process by which aggressive tumors spread throughout the body. Aravive Biologics, founded by Prof. Giaccia, is leveraging this research as a targeted therapy (AVB-500) for ovarian cancer. When left untreated, ovarian cancer is the deadliest reproductive cancer in women, especially women over the age of 50. Women with advanced stage ovarian cancer who receive standard-of-care often relapse and develop drug resistance. The engineered protein works by starving a cell signaling pathway known as GAS/AXL, which drives tumor progression. Clinical trials for ovarian and clear cell renal cancer are currently in progress with plans for further evaluation in additional tumor types, including acute myeloid leukemia, triple-negative breast cancer and pancreatic cancer.

Leading Research in Functional Genomics

In 2000 the Stanford Genome Technology Center (SGTC) shifted its focus from DNA sequencing to the study of functional genomics, particularly the human genome. Under the direction of Prof. **Ron Davis**, SGTC researchers have developed many cost-effective, cutting-edge technologies that have been patented and transferred to the commercial sector. By the mid-2000s the SGTC had spun off ten companies, including ParAllele Bioscience (acquired by Affymetrix in 2005), Ingenuity Systems (acquired by QIAGEN in 2013) and NextBio (acquired by Illumina in 2013). In 2011 Davis was awarded the Gruber Genetics Prize for his groundbreaking discoveries in molecular genetics and genomics. Prof. **Lars Steinmetz** joined Davis as Co-Director of the SGTC in 2013. As of April 2021 the Center reported a total of 30 spinoff companies and 60 issued patents.

ICO Master Agreements

By the end of the decade ICO had established many important Master Agreements with leading industry partners that are still ongoing in 2021. Boeing has sponsored Prof. **Olav Solgaard**'s research in optical networks and sensor systems for aircraft, and provides funding to other Stanford researchers. Volkswagen provides support to Prof. **Fritz Prinz**'s lab in fuel cell research. Varian sponsors work in the Radiation Oncology department and has collaborations with SLAC National Accelerator Lab. The Philips-sponsored inventions from Prof. **Craig Levin**'s lab are centered on improving the attenuation correction for positron emission tomography (PET). GE sponsors medical and biomedical imaging research in the Departments of Radiology and Electrical Engineering, including MRI, digital x-ray, computed tomography, ultrasound and molecular imaging.

> **"Discoveries arising from artistic and scientific curiosity have been successfully promoted by OTL and it's a partnership that over the decades has helped sustain the freedom to pursue interdisciplinary research at the center."**
>
> **—PROF. CHRIS CHAFE**

2004

Stanford Cancer Center opens.

2006

Prof. Andrew Fire receives the Nobel Prize in Medicine.

Prof. Leonard Herzenberg receives the Kyoto Prize.

Prof. Roger Kornberg receives the Nobel Prize in Chemistry.

2007

Prof. Gary Steinberg discovers that stem cells transplanted into the brains of rats navigate toward areas damaged by stroke.

2009

Prof. Irving Weissman identifies the stem cell that gives rise to bladder cancer and shows how the cell uses the "don't eat me" signal.

2010s TRANSITION

The 2010s ushered in groundbreaking advances in medicine such as CRISPR/Cas9 for editing living organisms, the synthetic genome, antiretroviral therapy for HIV, immunotherapy drugs for treating cancer, the artificial pancreas, the Ebola vaccine, and transcatheter aortic valve replacement. Virtual assistant devices, drones and the self-driving automobile made significant progress. Scientists at CERN discovered the elusive Higgs boson particle, confirming that particles acquire mass as described by the Higgs mechanism and filling in the final missing piece of the Standard Model of Modern Physics.

Girls from India exploring with the Foldscope

> "At Stanford, it represents a badge of honor to create a startup. Not all institutions are that supportive, and I'm really appreciative of the Stanford support."
> —PROF. BILL ROBINSON

Foldscope

Prof. **Manu Prakash** and graduate student **Jim Cybulski** invented an ultra-affordable, easily assembled paper microscope with 140x magnification and 2 micron resolution. With these capabilities, it's possible to view extremely tiny bacteria, blood cells, single-celled organisms and more. As of 2020, over one million Foldscope units have been distributed to classrooms and communities throughout the world.

ICO Contract Funds EV Battery Research

A major challenge in designing ultra-fast-charging batteries for electric vehicles is finding a fast charging method that doesn't damage the battery. Both the time per experiment and the number of experiments make this optimization a long, expensive process. Profs. **Stefano Ermon** and **William Chueh** received funding to study this problem through an agreement completed by the Industrial Contracts Office and the Toyota Research Institute. The researchers designed machine learning-based programs to reduce the total testing time. One program predicts the final lifetime of the battery, while Bayesian optimization learns from its experiences to quickly find the best protocols to test. Using this AI approach, the researchers were able to reduce the testing process from almost two years to 16 days.

2010

The Li Ka Shing Center for Learning and Knowledge opens.

Prof. Carolyn Bertozzi receives the Lemelson-MIT prize.

2011

Prof. Patrick Brown founds Impossible Foods, Inc., a company that develops plant-based substitutes for meat products.

2012

Prof. Stephen Quake receives the Lemelson-MIT prize.

Prof. Brian Kobilka receives the Nobel Prize in Chemistry.

2013

Prof. Thomas Sudhof receives the Nobel Prize in Medicine.

Prof. Michael Levitt receives the Nobel Prize in Chemistry.

Stanford engineers build a computer using carbon nanotubes.

Prof. Karl Deisseroth develops CLARITY, a process that renders brain tissue from mice transparent.

Soft Growing Robot

Researchers in Prof. **Allison Okamura**'s lab developed a robot that grows. Based on the mechanism of eversion, the flexible robot turns inside out as material emits from the tip, potentially growing to a very long length. Using software, the researchers can guide the robot along convoluted paths in difficult-to-reach places. While the robot body may remain in one place, the tip continues to grow. Applications include search and rescue, lifting heavy objects, and delivering sensors or life-saving materials into tight or dangerous spaces. The robot could also advance medical procedures. Rather than pushing a tube through the body, this soft robot could grow without dragging on delicate tissue.

Seizure Detection Device

Music Prof. **Chris Chafe** and Neurology Prof. **Josef Parvizi** developed a technology for a wearable device that offers instant electroencephalography (EEG) recording and interpretation and helps physicians detect seizures. The Brain Stethoscope function simplifies interpretation of EEG results by converting brain signals into sound, which allows physicians to hear changes in brain activity and make instant diagnoses of seizures.

Efficient Isolation of Human Immunoglobulin Genes

Developed by Prof. **Bill Robinson**, this high-throughput DNA sequencing method allows researchers to isolate immunoglobulin genes from human B cells. The technology enables the generation of human monoclonal antibodies with high specificity and affinity. In 2000, Prof. Robinson founded the company, Atreca, which is using the technology to discover antibodies in cancer patients in order to create novel cancer immunotherapeutics.

Boppli™ monitoring device shown with neonatal infant

Artificial Skin

Researchers in Prof. **Zhenan Bao**'s lab developed an artificial skin composed of a nanoscale pressure sensor sealed inside layers of plastic. Sensors inside the plastic skin provide continuous physiological monitoring of heart rate, diastolic blood pressure, systolic blood pressure and arterial stiffness without the pain and risk of an arterial line. Licensed by PyrAmes (co-founded by Prof. Bao and Dr. **Xina Quan**), the technology received Breakthrough Device Designation by the FDA for continuously monitoring the blood pressure of babies in the neonatal intensive care unit. PyrAmes will offer wearable devices to provide accurate, non-invasive, and wireless blood pressure monitoring for patients of all ages, from newborns to seniors.

ATAC-seq

Developed in 2012 by Profs. **William Greenleaf** and **Howard Chang**, ATAC- seq (Assay for Transposase-Accessible Chromatin with high throughput sequencing) analyzes chromatin accessibility at the single cell level. This breakthrough technology provides insights into cell types and states, allowing deeper understanding of gene regulatory mechanisms.

2014

Prof. Maryam Mirzakhani receives the Fields Medal in Mathematics.

Prof. W.E. Moerner receives the Nobel Prize in Chemistry.

Prof. Patrick Hanrahan receives an Academy Award for Technical Achievement.

Prof. Tony Wyss-Coray finds that infusing the blood of young mice into the brains of old mice recharges the older brains.

2016

Prof. Calvin Quate, with Gerd Binnig and Christopher Gerber, receives the Kavli Prize. for developing the Atomic Force Microscope.

Prof. Karl Deisseroth receives the Kyoto Prize in Biotechnology.

2019

Stanford Redwood City campus opens in March; the new Stanford Hospital opens in November.

Stanford launches the Institute for Human-Centered Artificial Intelligence; Stanford and SLAC launch the Q-Farm initiative to expand research in quantum science.

2020 MOVING FORWARD IN THE YEAR OF THE PANDEMIC

The COVID-19 pandemic dominated 2020, impacting all aspects of society. Previous research on coronavirus vaccines helped to accelerate the initial development of new COVID-19 vaccines. Other breakthroughs included the use of artificial intelligence/AI to predict protein folding for drug development, advances in robotic lower-limb exoskeletons for rehabilitating or augmenting walking and running, and the advent of programmable synthetic biological organisms known as "xenobots." By the end of 2020 it became apparent that major automakers will soon be introducing prototypes of electric vehicles powered by solid-state batteries, with commercialization projected to increase over the coming decade.

> "The coronavirus pandemic has reinforced the vital role that universities like Stanford have to play in our modern world. The mission of developing and disseminating knowledge has never been more urgent."
>
> —PRESIDENT MARC TESSIER-LAVIGNE, OPEN LETTER TO THE STANFORD COMMUNITY, MAY 2020

COVID-19 Innovations and Pipeline

When the World Health Organization declared COVID-19 a global pandemic in early March, OTL responded quickly by co-developing the COVID-19 Technology Access Framework with Harvard and MIT to incentivize technology transfer strategies that facilitate rapid, equitable access to university innovations. The Framework's guidelines establish patenting and licensing principles that allow critically important technologies for preventing, diagnosing, or treating COVID-19 infections to be expeditiously deployed for the greatest public benefit. The Framework encourages the use of rapidly executable, non-exclusive, royalty-free licenses with a commitment to distribute the resulting products in a manner that ensures broad access. There are 24 institutional signatories, and AUTM, along with several other universities, that implemented similar guidelines during the pandemic.

Transparent Air Filter for High-Efficiency PM2.5 Capture

Profs. **Yi Cui** and **Steven Chu** formulated a transparent PM2.5 air filter using electrospinning, a technique that uses strong electric fields to stretch polymer solutions or droplets into extremely thin fibers. Originally developed for use in window screens to combat air pollution, the technology is now also being used by 4C Air—co-founded by Cui and Chu—for high-efficiency KN95 face masks.

2020

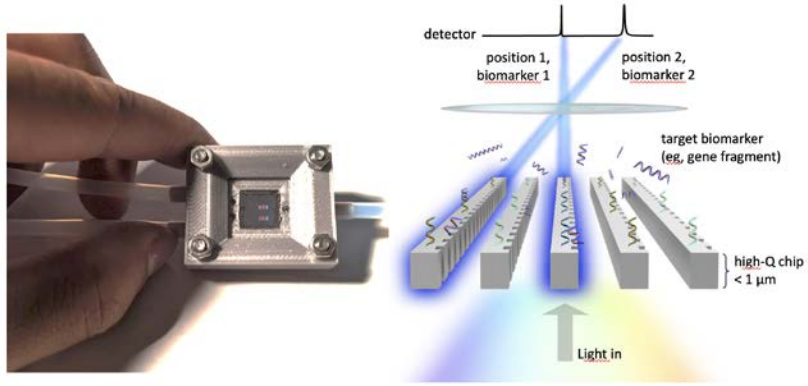
JAN 9
WHO announces mysterious virus in Wuhan, China.

FEB 24
OTL receives first COVID-related invention disclosure.

MARCH 11
WHO declares COVID-19 a global pandemic.

COVID-19 Diagnostics

The COVID-19 global pandemic exposed the critical need for rapid, inexpensive, point-of-care diagnostics. Researchers in Prof. **Jennifer Dionne**'s lab developed a handheld technology that uses optical characterization to rapidly and quantitatively measure extracted viral-RNA target binding or antibody binding to nanofabricated platforms. The invention detects extracted viral- RNA gene sequences from the SARS- CoV-2 genome that encode for various types of proteins. The technology can also be used for other viral or bacterial infections.



Prototype of hand-held device (left) and schematic illustrating optical characterization process to detect extracted viral-RNA gene sequences from the SARS-CoV-2 genome (right)

COVID-19 Vaccines, Therapeutics, Other Tools

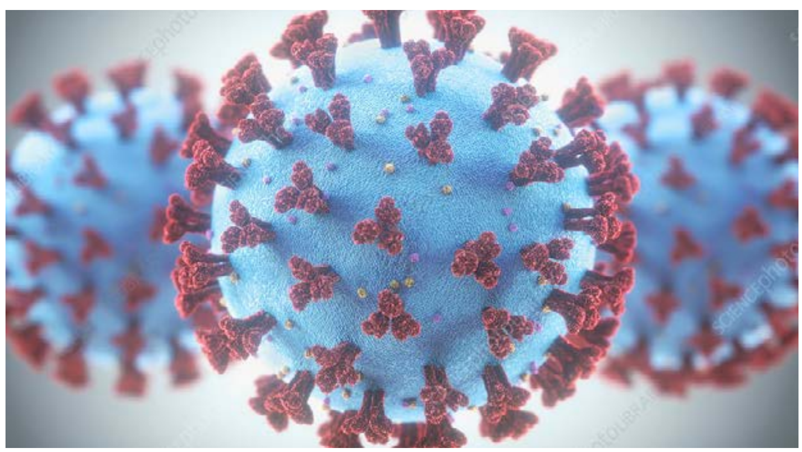
Motivated by the COVID-19 pandemic crisis, Stanford researchers led by Profs. **Rhiju Das** and **Maria Barna** developed a portfolio of RNA-based vaccine innovations, therapeutics, tools, and methods. These technologies advance the rational design of shelf-stable and rapidly deployable mRNA vaccines and include an unprecedented database of RNA structures, best-in-class computational tools, and optimized methods of synthesis and assessment.

ETERNA ENTERPRISE

Developed in the Das lab, “Eterna” is an online application that integrates RNA folding algorithms, a video game interface, and associated computational methods to revolutionize vaccine design and RNA structure prediction. The new invitation-only version of the platform, Eterna Enterprise, allows selected participants to work confidentially on problems, such as designing improved mRNA vaccines, that can be translated to clinical trials by industry partners and other collaborators. The data and designs Eterna Enterprise users generate may be used to develop improved mRNA vaccines immediately for the COVID-19 pandemic.

OPTIMIZING RNA-BASED THERAPEUTICS

High-efficiency, high fidelity, robust production of mRNAs is essential for developing RNA-based therapeutics. Researchers in the Barna Lab have discovered that the SARS-CoV-2 5′ untranslated region (5′-UTR) can be repurposed for enabling optimal expression of proteins and enhanced stability when producing mRNA vaccines.



APRIL
Prof. Andrea Goldsmith becomes the first woman to win the Marconi Prize.

APRIL
Release of Technology Access Framework with Harvard and MIT.

2020 MOVING FORWARD IN THE YEAR OF THE PANDEMIC

Covering New Ground with Forty Seven

Forty Seven, a Stanford licensee co-founded by Profs. and co-inventors **Irving Weissman** and **Ravindra Majeti**, was acquired by Gilead for $4.9B in April 2020. While the financial aspects generated a good deal of press, the most exciting part of this story is the success of the science and the opportunity for a biopharmaceutical company with experience in developing FDA-approved drugs to realize the potential of the technology to treat a wide variety of cancer types, with an initial focus on solid and hematological cancers. The CD47 cell receptor was discovered by Prof. Weissman in the 1980s, as a fundamental surface protein used by cells to signal "don't eat me" to macrophages. Cancer exploits the CD47 biology to cause the body's own immune system to no longer recognize the cells as cancerous. By diminishing the exposed CD47 proteins on a cancer cell's surface using a variety of methods such as antibody attachment, it is possible to again allow the macrophages to recognize the cells as cancerous and to destroy them via phagocytosis. This is a mechanism that is extremely broad in different cancer types and could lead to numerous therapies.

The work at Stanford to understand and develop therapies that exploit the CD47 pathway, and lay a solid groundwork for later commercialization, was partly the result of new approaches taken by the Weissman group and by OTL. These new approaches were important for the later success of Forty Seven and its integration into a major pharmaceutical company like Gilead.

A prolific inventor, Prof. Weissman understood the long translational path from "bench to bedside" that an academic discovery would require. He believed that the discoveries related to CD47 needed to be nurtured within the academic environment for an extended period, to develop sufficient understanding and tools to exploit the pathway for cancer therapeutics. That included a long phase of fundamental science that started with an NIH-funded grant in 1985. The first patent was not filed until 2005, once the mechanisms had been elucidated to the point that therapeutic approaches could be defined.

As recounted by Gregg Kyle, a former Senior Licensing Associate who managed this intellectual property (IP) portfolio, OTL's close collaboration with Weissman group was one of the first intentional efforts to build up a large and coherent body of IP that would provide strong protection for a commercialization partner. According to Gregg, OTL sought IP strategy advice from industry experts and provided guidance to the inventors on actions that could be taken to create the strongest possible patents. He described this as one of the closer hands-on relationships that OTL had ever had with a research group at Stanford, a collaboration that led to a portfolio of 52 total inventions.

In 2015, after CIRM had awarded a $6.5M grant to Stanford to begin clinical testing of one of several technologies in the portfolio, various factors came together making it an opportune time to begin commercial efforts. Prof. Weissman, together with Prof. Ravindra Majeti, led the way as founders of Forty Seven, taking a license from Stanford to 31 inventions, with 5 more being added thereafter. Gilead is now conducting clinical trials of the first potential product from the Stanford portfolio, including a Phase 3 trial for myelodysplastic syndrome, as well as two different Phase 1b/2 trials for acute myeloid leukemia and for diffuse large B cell lymphoma.

2020

JUNE 11
Stanford President Marc Tessier-Lavigne receives the Gruber Neuroscience Prize.

JUNE 25
Stanford's first license for a COVID-19 technology is signed with licensee Ocean Biomedical.

High-Potential Innovations Translation (HIT) Fund

OTL was founded with a business-focused model to transfer technology for society's use and benefit and to generate unrestricted income to help the University further its research and education mission.

Its mantra has always been "Do what's best for the technology" and flexibility has been the hallmark of its interactions with inventors and companies. Despite the solid foundation of the OTL enterprise and its vast experience in licensing, there is still the ever-present wicked problem called the Valley of Death which keeps most university innovations on laboratory benches rather than in factory production lines.

Stanford has been able to partially address this issue through a number of entrepreneurship and translational research funding programs. However, most are focused on a particular School's or Institute's research area. For example, SPARK and BioDesign (in the School of Medicine) are focused on healthcare, whereas the Precourt Institute's TomKat Innovation Transfer and Woods Institute are focused on the environment.

As a University administrative unit under the Dean of Research Office, OTL has broad visibility and connections to all areas of research across campus and is well-positioned to fill the gaps and needs that aren't being addressed by the existing translational programs. It is with this unique perspective that the OTL is launching the High-Potential Innovations Translation (HIT) Fund to increase the number of Stanford innovations that can have a significant positive impact in society. A particular emphasis will be placed on supporting projects that align with Stanford's Long Range Vision.

The experiences from within Stanford and peer institutions' entrepreneurship and translational funding programs, as well as prior OTL programs, are informing the new campus-wide funding program. The HIT Fund will provide funding grants and mentoring to shepherd entrepreneurial teams with high potential innovations along a rigorous track that includes an OTL-facilitated program with a Lean Startup orientation.

The target is for the HIT Fund to issue a Call for Proposals by academic year 2021-22, open to all Schools on campus.

OCTOBER 12
Profs. Paul Migrom and Robert Wilson receive the Nobel Prize in Economics.

Year in Review

LICENSING FACTS AND FIGURES

In FY2020, Stanford received $114M in gross royalty revenue and equity from 847 technologies, with royalties and equity ranging from $4 dollars to $67.3M dollars. 84 of the 847 technologies generated $100,000 or more in royalties or equity. Ten inventions received $1M or more.

While the percentage of technologies that brought in more than $100,000 or even $1M in FY2020 increased significantly from the previous five years, 90% of our technologies that generate less than $100,000 in royalties are major contributors to the steady royalty base for Stanford.

We evaluated 594 new technology disclosures and signed 121 new licenses. 56 of the licenses were nonexclusive, 35 were exclusive and 30 were option agreements. 42 of the 121 agreements were with Stanford startups and 23 of them involved equity.

Royalty Distribution

Stanford's royalty-sharing policy provides for the distribution of cash net royalties (gross royalties less 15% for OTL's administrative expenses, minus direct expenses) to inventors, their departments, and their schools. OTL distributed personal income totaling $10.14M to 978 inventors. Stanford departments received $9.55M and schools received $8.35M after the University assessed an infrastructure charge on their shares of royalty income.

Our equity holdings in 18 companies were liquidated, which generated $73M. Stanford also paid 44 other organizations $3.25M for jointly-owned technologies for which Stanford has licensing responsibility.

Expenses

Filing and maintaining patents for Stanford's large portfolio of inventions is expensive. We spent $14.57M in legal expenses, although more than 64% of our legal expenses were eventually reimbursed by licensees or from royalty payments. Our operating budget for the year (excluding patent expenses) was $9.03M.

Equity

As of August 31, 2020, Stanford held equity in 181 companies as a result of a license agreement. During FY2020, equity from 18 companies was liquidated, generating $73M in revenue.

Stanford normally sells securities acquired as part of the licensing process promptly after they become freely tradeable on public markets.

This year, we signed licenses that include equity with 23 companies. There were 22 new startups based primarily on Stanford technology that received an option or license in FY2020.

As mentioned above, we also received $73M in liquidated equity from 18 companies.

$114M

IN GROSS ROYALTY REVENUE FROM

847

TECHNOLOGIES

84

TECHNOLOGIES GENERATED $100,000 OR MORE IN ROYALTIES

10

TECHNOLOGIES GENERATED $1M OR MORE IN ROYALTIES

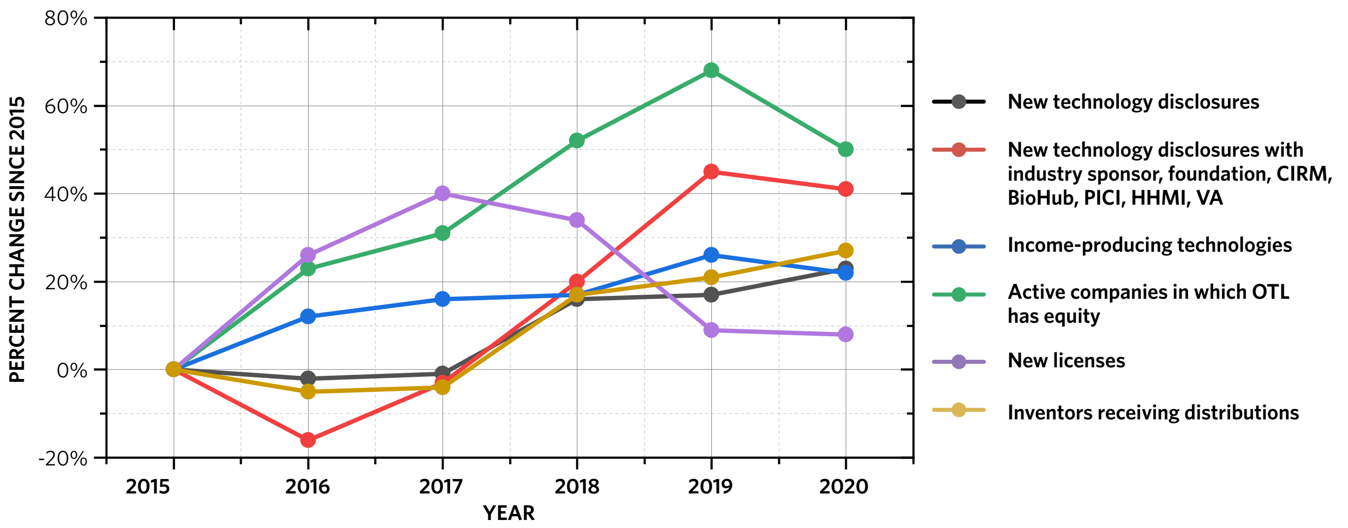
New Disclosures

In FY2020, we received 594 new inventions. One of the most challenging responsibilities for OTL is to decide whether or not to spend University funds on filing patents. Many inventions do not need to have a patent in order to license the technology.

Stanford Trademark Enforcement Fund and Patent Expenses

The Stanford Trademark Enforcement Fund (STEF) was established to support the costs associated with the protection of the Stanford name and associated logos and trademarks. In addition, some of the funding is used to provide support to OTL. STEF is currently funded sufficiently to cover the original intent and the OTL will no longer be deducting STEF fees for the foreseeable future.

FIG. 1: LICENSING TRENDS



The figure above shows trends for OTL-Licensing over 5 years, with the ratio of change relative to 2015.

594 NEW TECHNOLOGY DISCLOSURES

121 NEW LICENSE AGREEMENTS

- **56** NON-EXCLUSIVE
- **35** EXCLUSIVE
- **30** OPTION AGREEMENTS

42 AGREEMENTS WERE WITH STANFORD STARTUPS

Year in Review

INDUSTRIAL CONTRACTS OFFICE

The Industrial Contracts Office (ICO) is a group within OTL that specializes in research agreements with industry. In FY2020, ICO finalized a total of 153 new industry sponsored research agreements (SRAs) where companies fund and sometimes collaborate on research projects at Stanford and 219 amendments to existing SRAs.

The School of Medicine accounted for half of these agreements with 74 new industry-funded research agreements. The Department of Medicine was home to the largest number of new industry research agreements, with 70 new SRAs. The Pathology Department in the School of Medicine had 5 new SRAs, Radiology accounted for 8, Biomedical Data Science accounted for 6, and Pediatrics had 7 new SRAs.

The School of Engineering accounted for nearly half of the total SRAs, with 63 new industry-funded research agreements and 65 amendments to existing SRAs. The Electrical Engineering Department was home to the largest number of new Engineering industry research agreements, with 13 new SRAs; Chemical Engineering had 11, Mechanical Engineering had 9; Computer Science accounted for 9; and Materials Science and Engineering accounted for 9 new SRAs.

ICO provided expertise and guidance on intellectual property terms and Stanford policy to faculty, staff and partner organizations on an additional 460 transactions in FY2020, up from 354 in FY 2019.

Industrial Affiliates Programs

ICO also handles Industrial Affiliates Program approvals, renewals and related agreements. During the year, 74 programs brought in a total of $38.4M. SystemX in the School of Engineering continued to be the largest program, with $5.7M in funding.

Eight new Affiliates Programs were approved in the past fiscal year, including two in the School of Medicine, three in the School of Law, and three in the School of Engineering:

SCHOOL OF MEDICINE

- Center for Artificial Intelligence in Medicine & Imaging (AIMI)
- Canary Center & PHIND at Stanford Industry Affiliate Program

SCHOOL OF LAW

- Rockdata Affiliate Program
- Stanford Program in Law, Science & Technology (LST)
- Rock Center for Corporate Governance Affiliate Program

153
NEW INDUSTRY-SPONSORED RESEARCH AGREEMENTS

74
AFFILIATES PROGRAMS BROUGHT IN
$38.4M

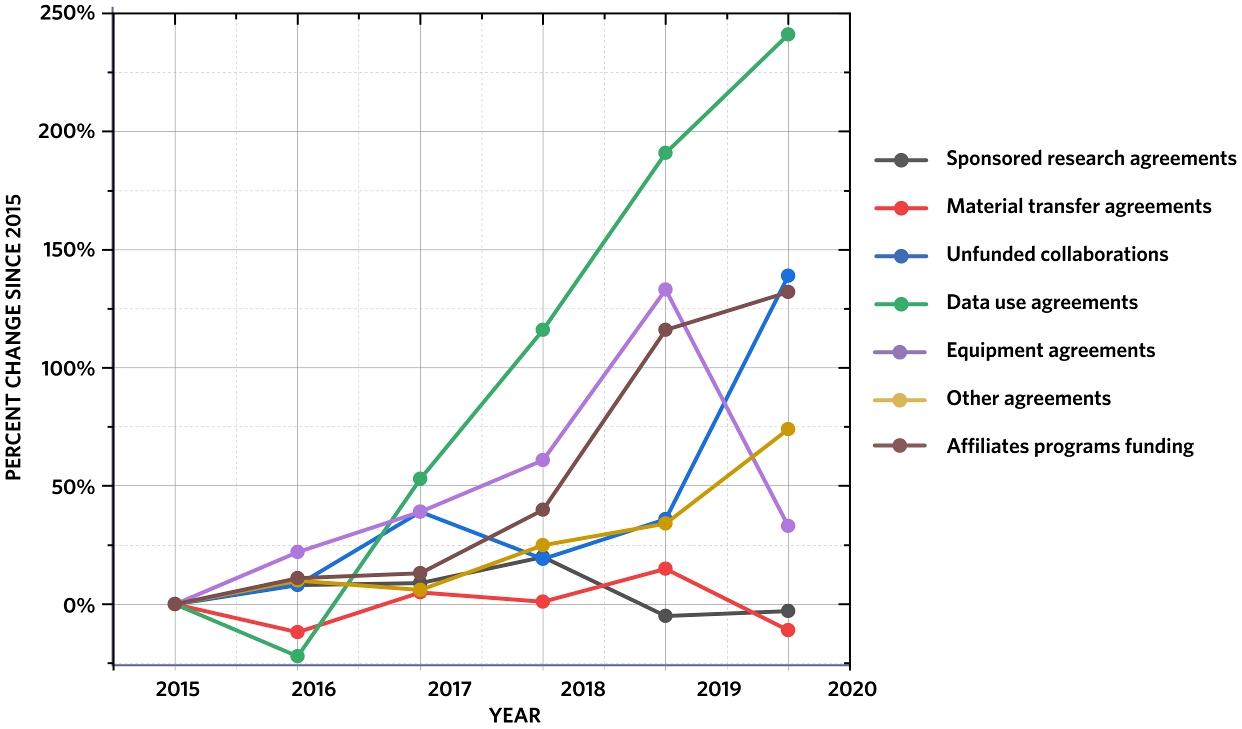
8
NEW AFFILIATES PROGRAMS WERE APPROVED

SCHOOL OF ENGINEERING

- Future of Digital Currency Initiative
- Stanford Computer Science (CS) Bridge Program
- Stanford Open Virtual Assistant Lab (OVAL)

All in all, ICO finalized 1,574 agreements in FY2020. This includes 538 Material Transfer Agreements (MTAs); 88 Human Tissue Transfer Agreements; 86 Unfunded Collaborations; 109 Data Transfer Agreements; 24 Equipment Loans and a variety of other research-related agreements with companies.

FIG. 2: AGREEMENT TRENDS



The figure above shows trends for ICO over 5 years, with the ratio of change relative to 2015.

ICO FINALIZED

1,574

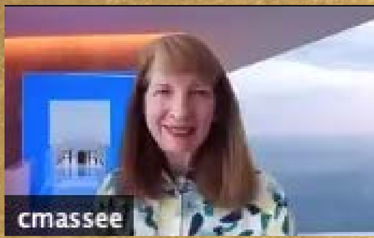
NEW AGREEMENTS

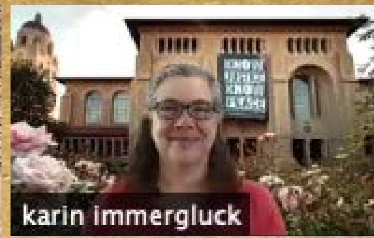
538

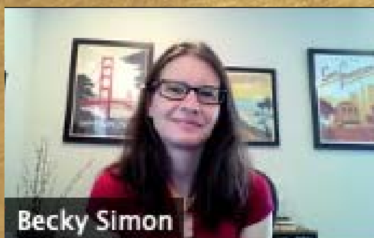
NEW MTAS

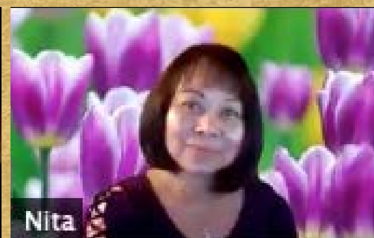
109

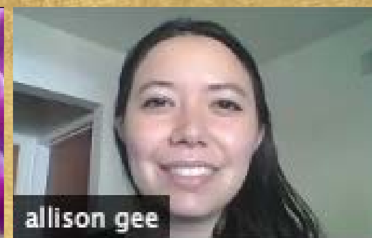
DATA USE AGREEMENTS

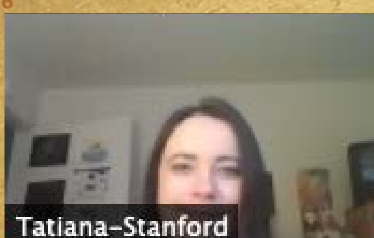


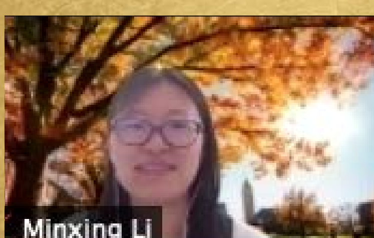






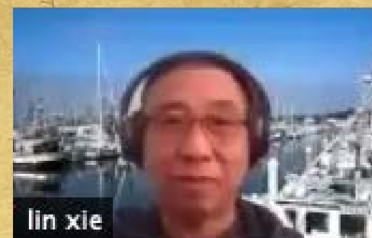


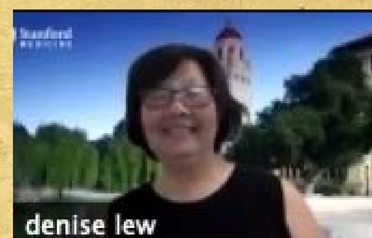


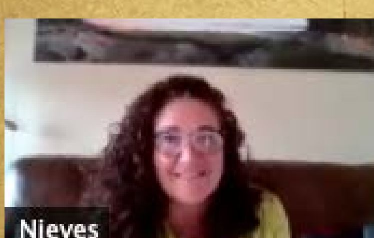


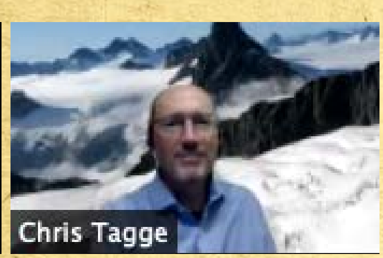
A sincere thank you to the entire Stanford community for the past 50 wonderful years of entrusting us with your cutting edge innovations. OTL is honored to be able to help Stanford researchers and their inventions reach beyond academia and impact humanity for the better.

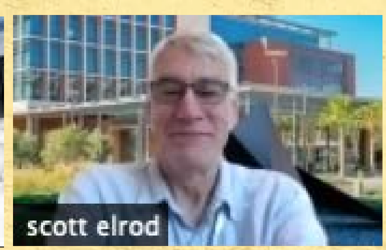
Considering the extraordinary challenges of the past year, we are grateful to everyone who has taken on the responsibility of protecting one another's health, and giving the support and cooperation needed to keep us all safe and well. We wish you good health and well-being in the years ahead.

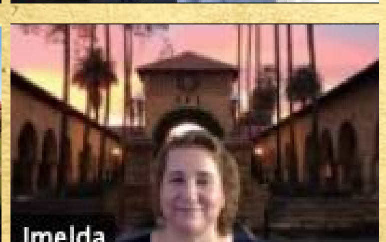










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