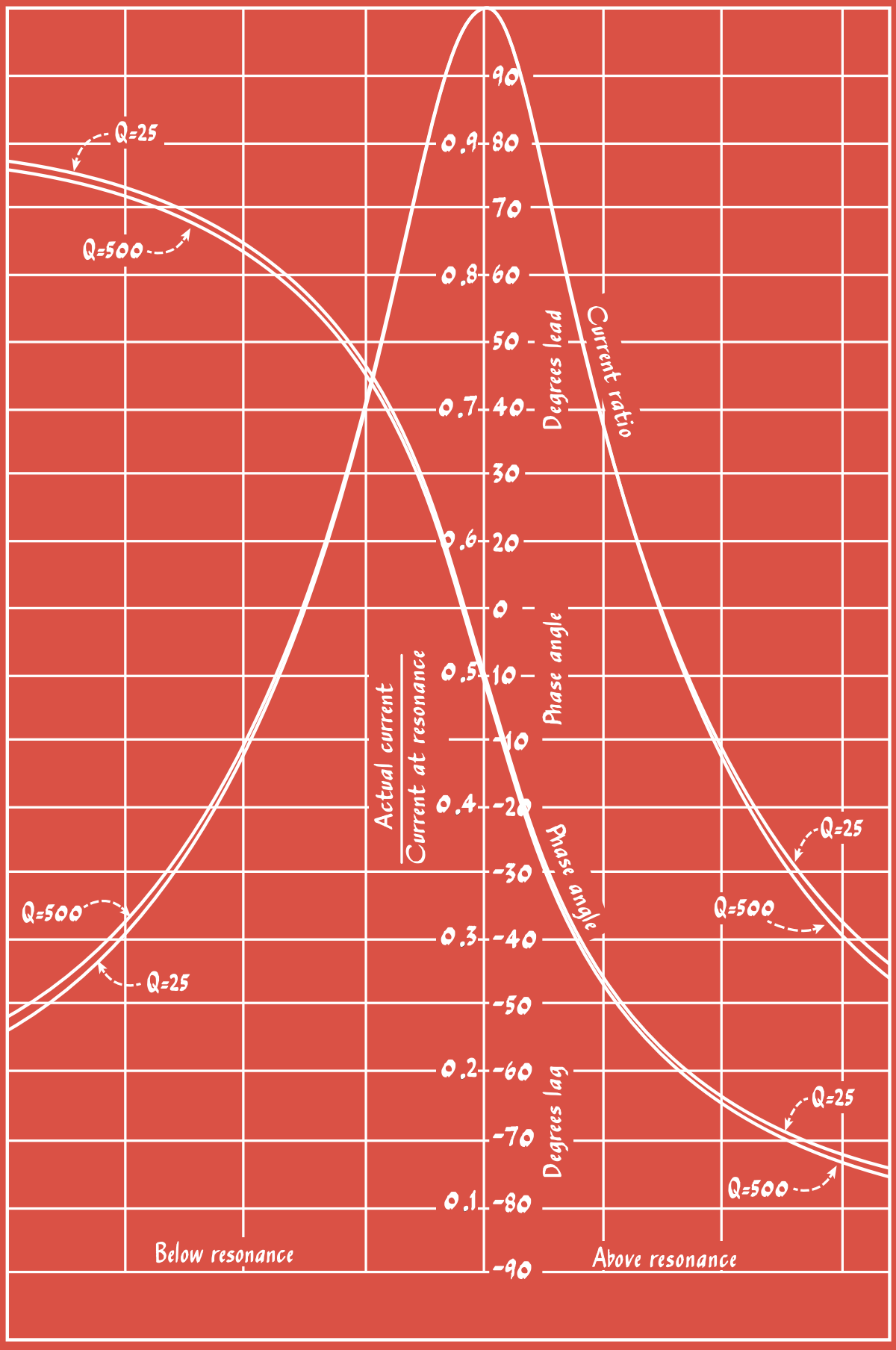
ENTREPRENURTURE

The STANFORD OFFICE of TECHNOLOGY LICENSING
ANNUAL REPORT
2010/11

Neuroscientist and psychiatrist Karl Deisseroth, associate professor of bioengineering and of psychiatry and behavioral sciences, has pioneered the use of optogenetics as a way of better understanding brain circuitry. Through optogenetics, scientists can use genetic engineering to switch neurons on and off with pulses of light.

Much of the world is focused on trying to encourage entrepreneurial thinking and initiative. In Silicon Valley, entrepreneurship needs little encouragement because it seems to be in the air we breathe and the water we drink.

Sometimes it seems that everyone wants to start a company.



In his 1932 book *Radio Engineering*, electrical engineer Fred Terman, who later became provost, presented the universal resonance curve, which simplified the approximate analysis of radio circuits with a range of center frequencies and Q values.

AN ENTREPRENEURIAL ECOSYSTEM

Stanford is frequently the place where the kernel of an idea for a new company takes root and begins to grow.

Provost Fred Terman encouraged students William Hewlett and David Packard to start a company based on their interests around audio oscillators, which were later sold to Disney for the movie *Fantasia*. Russell and Sigurd Varian helped found Varian Associates which developed the klystron tube, a high-frequency amplifier for generating microwaves that became an essential component of the modern medical linear accelerator.

Silicon Graphics was started by then Associate Professor Jim Clark. Alumnus Andreas Bechtolsheim founded Sun Microsystems along with a couple of Stanford business students. Cisco Systems and MIPS Technologies were started

AS MANY PEOPLE HAVE OBSERVED ABOUT STANFORD, "IT'S OK TO EXPERIMENT"– AND TO FAIL. IT'S ALSO OK TO BE SUCCESSFUL, WILDLY SUCCESSFUL.

soon after. From Stanford's President Hennessy, who took a leave of absence during his career at Stanford to start MIPS, to Environmental Health and Safety staff members who started a company around a chemical inventory system called ChemTracker, Stanford people continue to be risk-takers who want to have a major influence on how their technology is developed and commercialized.

Now visitors from all over the country and the world come to Stanford to find the secret of Stanford's entrepreneurial culture. The secret, of course, is that there is no secret. It's a mindset. It's an approach. It's the Stanford culture. As many people have observed about Stanford, "it's ok to experiment" — and to fail. It's also ok to be successful, wildly successful. We believe in the steeples of excellence, both in academics and — for those who want to explore whether an invention may have a commercial purpose — in business.

FACULTY ENTREPRENEURS

Over the past decade, faculty entrepreneurs have continued a tradition of success. A few examples include:

Personalis, founded in 2011 by Professors Russ Altman, Euan Ashley, Atul Butte, and Michael Snyder to develop products for accurate and consistent genome interpretation applied to clinical medicine.

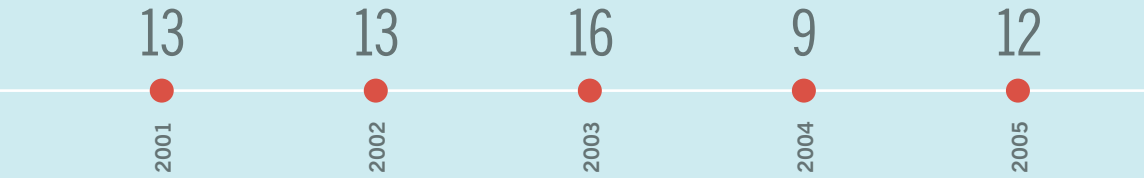
ImmuMetrix, started by Bioengineering Professor Steve Quake, based on technology to assess immune response where one application will be to assess transplant rejection.

Anacor, founded in 2002 based on technologies created by Professor Lucy Shapiro and Professor Stephen Benkovic at Pennsylvania State University. The technologies were methyltransferase genes and inhibitors that could be used as antimicrobial agents. Penn State took the lead in licensing to Anacor. Although our co-owned technologies did not pan out for Anacor, the company has multiple other compounds in clinical trials at this time. Anacor went public in November of 2010.

Circuit Therapeutics, co-founded by Professor Karl Deisseroth, is based on the field that Professor Deisseroth established called optogenetics. Optogenetics permits the modulation of neural function using light. It has led to new methods for drug discovery and for building devices that modulate neural function relating to depression, controlling hunger, pain, and many other human maladies where increasing or downregulating neural function can provide a therapeutic result.

ASSIA Inc., founded by Professor John Cioffi in 2003, is the leading provider of high-performance software tools for Dynamic Spectrum Management of DSL networks. ASSIA's products enable DSL service providers to realize dramatic speed and reach improvements while lowering operating and capital expenses. ASSIA has more than 45 million lines under contract worldwide with top-tier service providers.

NUMBER OF COMPANIES IN WHICH OTL TOOK EQUITY



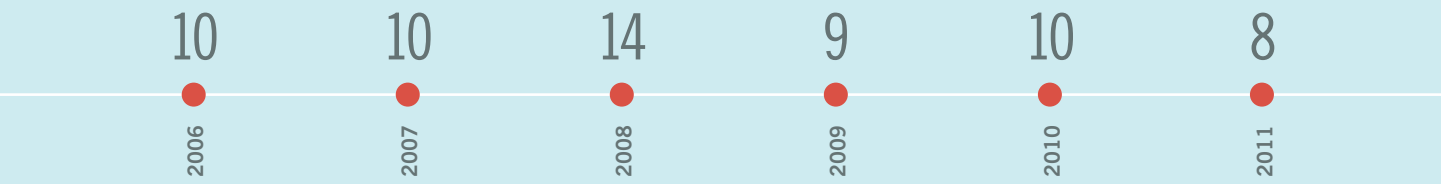
MokaFive, founded by Professor Monica Lam, is developing a new computing system architecture that is secure, reliable, easy to administer, and provides ubiquitous access to users' computing environments.

SwitchGear, started in 2006 by Nathan Trinklein and Shelley Force Aldred with Professor Rick Myers to develop products to study regulatory element function across the genome. Nathan and Shelley were graduate students in Professor Myers' laboratory and worked on the ENCODE (Encyclopedia of DNA Elements) Project Consortium to "identify functional elements in the human genome and develop this genomic contact into novel high-throughput cell-based functional assays." Before their first anniversary in business, SwitchGear was making sales. SwitchGear provides reporter assay products and services. Although local, the company has European and Japanese distributors.

Amprius, founded by Professor Yi Cui in May 2008 with the mission to develop and commercialize advanced materials and nanotechnology for improved energy storage.

Lyncean Technologies, Inc., founded in 2001 by Professor Ron Ruth of SLAC. The Compact Light Source represents a new generation of miniature synchrotron light sources for use in laboratories all over the world.

C3Nano, an early stage venture backed start-up developing a revolutionary new transparent electrode material for applications such as flexible displays, touch screens, solar cells and smart windows. C3Nano was founded in January 2010 based on research developed by Professor Zhenan Bao. C3Nano won the 2010 MIT Clean Energy Prize and the 2010 NASA Game Changer Technology Award.



A TEACHABLE SKILL?

One important question on everyone's mind is: Can entrepreneurship be taught? Can we teach the next generation to identify problems and come up with solutions in an entrepreneurial way so that these new innovations will impact the world?

Many Stanford professors and students believe the answer is a resounding "yes!" The number of classes on entrepreneurship has risen dramatically over the last 15 years. These classes reside in the Law School, the Business School, the School of Engineering and the School of Medicine. Although Stanford is very decentralized, the Stanford Entrepreneurship Network (SEN) seeks to bring Stanford's various entrepreneurship programs together under one informal umbrella organization. SEN started out as a grass-roots information-sharing initiative but has evolved into a focal point for Stanford's entrepreneurial activity.

One of the most established entrepreneurship programs on campus is the Stanford Technology Ventures Program (STVP), hosted by the department of Management Science and Engineering in the School of Engineering and led by Professor Tom Byers, Professor Kathy Eisenhardt, and Dr. Tina Seelig. STVP is dedicated to accelerating high technology entrepreneurship education and creating scholarly research on technology-based firms that, in turn, provides new insights for students, scholars, and business leaders. STVP offers over 30 courses to students across campus each year, supports a dozen Ph.D. students, and has extensive outreach efforts around the world, including their Entrepreneurship Corner website (ECorner.stanford.edu) with thousands of free videos and podcasts of entrepreneurial thought leaders.

Within Stanford's entrepreneurial ecosystem, undergraduate and graduate courses in entrepreneurship or "solution-based-learning" are ever more popular. One of the first of its kind was the Biodesign Program, championed by Dr. Paul Yock, whose mission is to train students, fellows, and faculty in the Biodesign Process: a systematic approach to the invention and implementation of new biomedical technologies designed to meet identified needs. The Biodesign Program has trained many leaders in medical technology and many related companies have been launched.

Stanford students have focused much of their entrepreneurship energy on solving developing world problems. The Graduate School of Business and School of Engineering offer a joint course entitled Entrepreneurial Design for Extreme Affordability. (http://extreme.stanford.edu/) The class is an intensive, two quarter, hands-on project course in which graduate students apply design, engineering, and business skills to create comprehensive solutions for challenges faced by the world's poor.

Professors Terry Winograd and Joshua Cohen have developed a new course at the Hasso Plattner Institute of Design (the d.school): Designing Liberation Technologies (http://hci.stanford.edu/courses/cs379l/2011/). Last year, their focus area was finding ICT solutions for the development and healthcare needs of people living in Kibera and Mathare, informal settlements around Nairobi. Many projects are supported by The Consortium for Innovation, Design, Evaluation and Action (C-IDEA, an $8 million dollar grant from the

NIH to accelerate contributions to global health in the developing world).

Designed for scientists and engineers but open to all Stanford students, Professor Steve Blank's Lean Launchpad class (http://stanford.edu/group/e245/cgi-bin/2012/) provides real world, hands-on learning on what it's like to actually start a high tech company. Students learn how to use a business model to brainstorm each part of a company and customer development research to see whether anyone will use the product. Students learn first-hand how agile development can help a company rapidly iterate a product to build something customers will use and buy. This class was adopted by the National Science Foundation as the curriculum for its Innovation Corps.

So it's not surprising that students have created many start-up companies, and some have licensed technologies from Stanford:

Google and Yahoo may be our most famous student start-ups. We have watched both companies grow from 2 students each to over 31,000 at Google and approximately 13,500 at Yahoo.

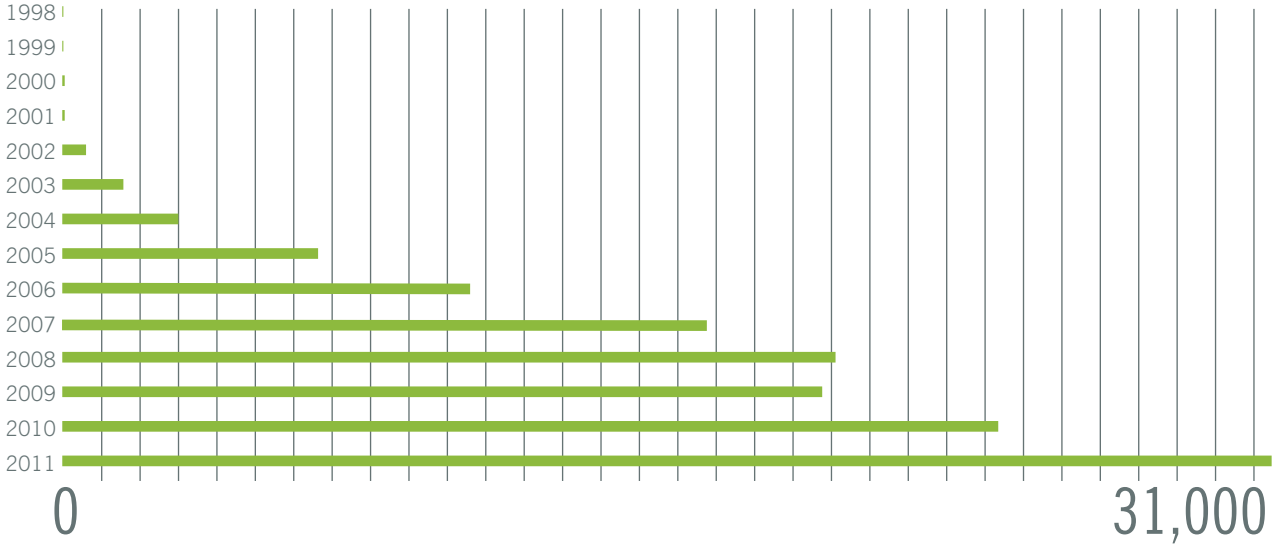
iRhythm, started by Biodesign Fellow Uday Kumar, has been selling the Zio, a patch that simplifies cardiac rhythm monitoring for patients suspected of having an irregular heartbeat, or arrhythmia.

Lytro (started by Stanford Ph.D. Ren Ng) has introduced the world's first light field cameras for consumers, which let you take and share pictures that can be interactively refocused after the shot. Cameras and pictures can be seen at http://www.lytro.com/.

Guidelines on how inventions are handled in entrepreneurial classes can be found at http://otl.stanford.edu/documents/studentbestpractices.pdf.

Faculty, too, have opportunities to learn about entrepreneurship. Professor Daria Mochley-Rosen and Dr. Kevin Grimes started the SPARK program to educate faculty and graduate students on what it takes to develop a therapeutic or diagnostic product in the biotechnology sector. With regular weekly meetings, this program has helped translate many medical school research projects into potential start-up companies. Start-up companies out of the SPARK program include Eiger, ImmuMetrix, Balance Therapeutics, Akrotome, and ALDEA.

GOOGLE EMPLOYEES



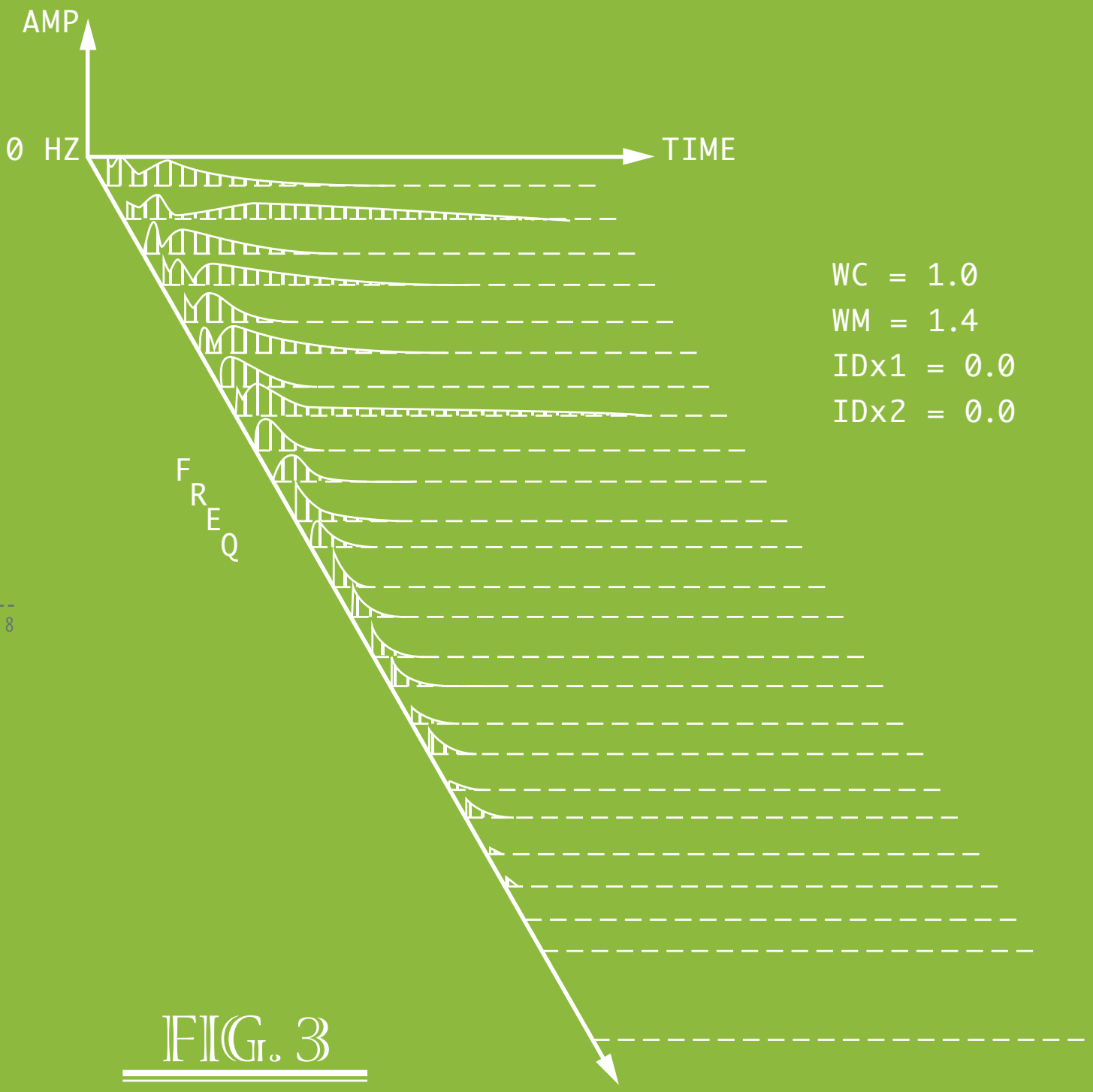


FIG. 3

This sketch by John Chowning, director of the Center for Computer Research in Music and Acoustics, illustrates his patent of the digital sound reproduction scheme in the early 1970s. His work led to the development of today's electronic keyboards. Chowning is the Osgood Hooker Professor of Fine Arts and Professor of Music Emeritus.

STANFORD "FARM TEAMS"

One of the experimental programs OTL initiated this year was the Stanford Innovation Farm (iFarm) Team program. The iFarm Team program, which draws upon Stanford's culture of innovation and its community of innovators, including students, faculty, alumni, and subject-specific experts, was started to advance the commercialization of selected Stanford inventions; it does so by giving those inventions a boost toward licensability.

The iFarm Team program improves OTL's chances of success with selected difficult-to-license inventions by applying some novel and aggressive approaches to technology licensing and commercialization, including:

- Creating "Farm Teams" around specific innovations;
- On-campus α & β-testing;
- Rapid prototyping of certain inventions;
- Funding a proof of concept experiment;
- Holding regular meetings (at least twice monthly) with each iFarm Team to review progress and make adjustments;
- Recruiting outside iFarm Team volunteers who are expert in specific subjects.

The program is unique insofar as it engages the broader Stanford community through the creation of teams; it is a readily scalable and sustainable program; and it is aimed at the physical sciences inventions. Each project will take about six months and the purpose is to give students and members of the community a chance to experience the challenges inherent in the further development and commercialization of an invention. iFarm Teams are expected to self-extinguish or, if appropriate perhaps, morph into the core of a start-up venture team. iFarm Team deliverables range from as little as compiling a more complete file of due diligence on a technology licensing opportunity to finding a strong licensee (and negotiating a license), to starting a company based on the technology.

With all this entrepreneurial activity, it's sometimes surprising to realize that only about 8–10 licenses per year (approximately 10% of OTL's licensing activity) are made to start-ups. OTL realizes that most Stanford technologies are early stage and that significant investment is essential in order to bringing such technologies to the marketplace. Start-up entrepreneurs must have a passion that borders on irrational optimism and faith in the technology along with an eagerness to commit their own time and resources to develop these inventions. OTL is willing to work with new companies to craft an agreement that can help them succeed. We do not claim to know which start-ups will be successful —— that's left to luck and hard work — but we want to help these new companies get a start.

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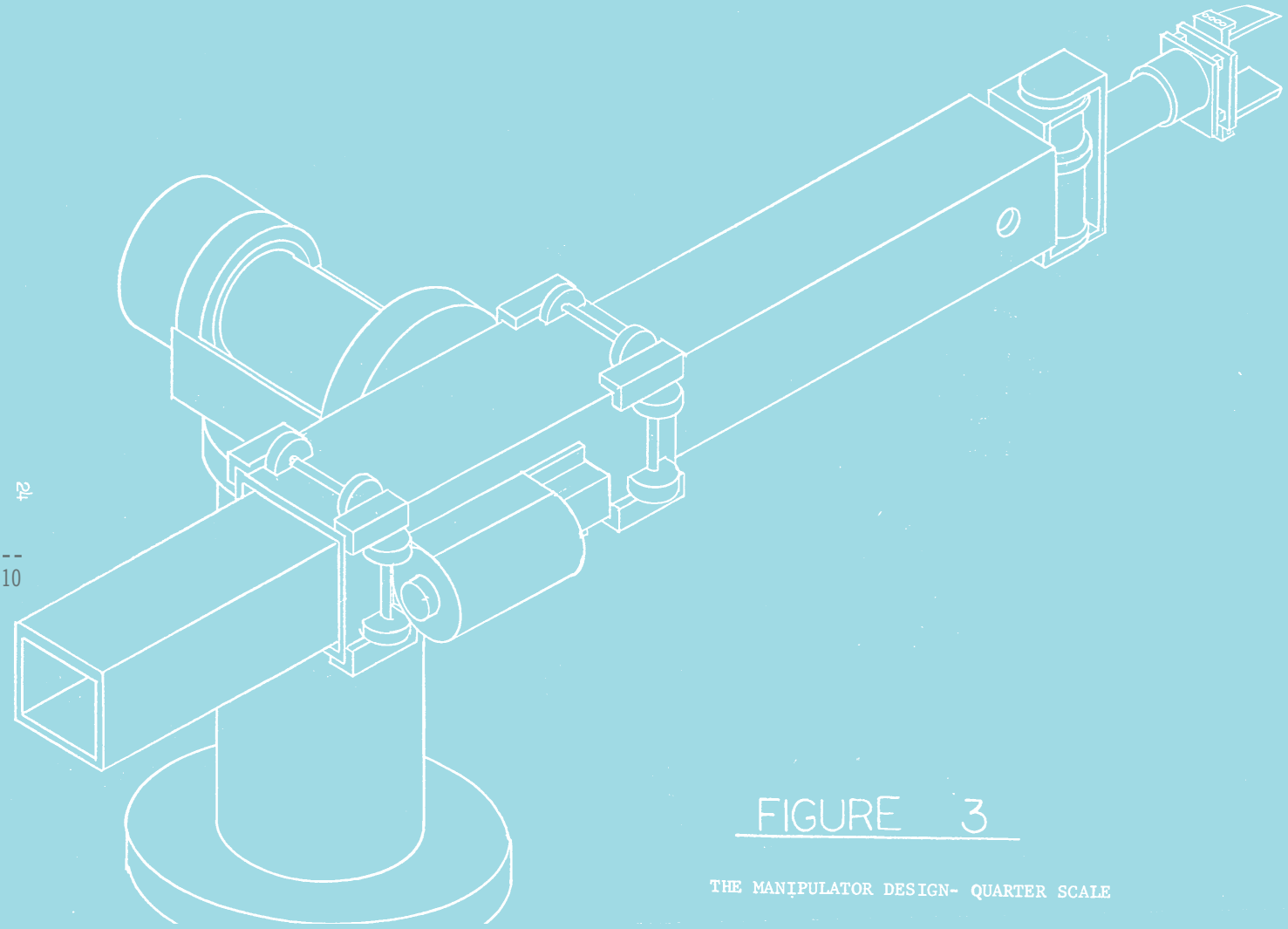


FIGURE 3

THE MANIPULATOR DESIGN- QUARTER SCALE

This illustration from the thesis of mechanical engineering graduate student Victor Scheinman, a pioneer in the field of robotics, shows the design of a computer controlled manipulator that became the model for later industrial robots.

THE YEAR IN REVIEW

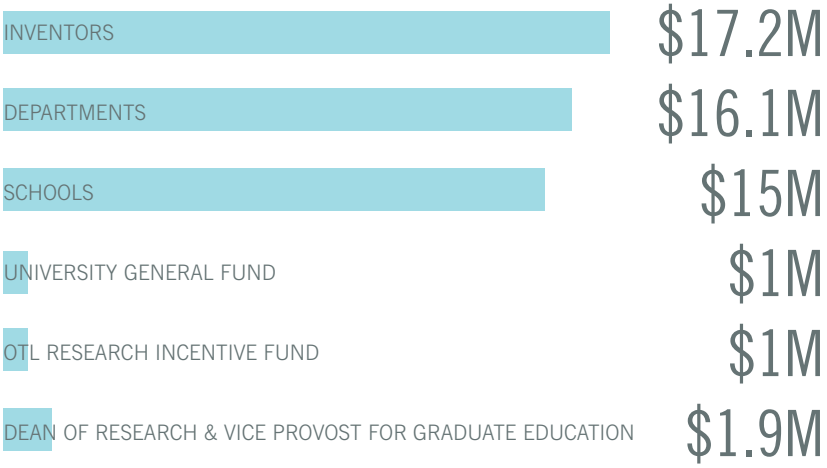
Stanford received $66.8M in gross royalty revenue from 600 technologies, with royalties ranging from $1.80 to $44M. Ninety-eight percent of the income came from licenses signed many years ago. Thirty-two of the 600 inventions generated $100,000 or more in royalties. Six inventions generated $1M or more. We have evaluated 504 new invention disclosures this calendar year, and concluded 101 new licenses. Of the new licenses, 51 were nonexclusive, 28 were exclusive, and 22 were option agreements.

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. In 2010-11, inventors received personal income of $17.2M, departments received $16.1M, and schools received $15M. The University assessed an infrastructure charge on the department and school shares of royalty income.

We contributed $1M to the University General Fund and $1M to the OTL Research Incentive Fund, which is administered by the dean of research for the support of early-stage, innovative research ideas, novel interdisciplinary research, cost sharing of shared instrumentation, and other research facilitation needs. In addition, we contributed $1,889,759 to the dean of research and vice provost for graduate education. This amount represents their portion of liquidated equity. Stanford also paid the University of California and other organizations $655,208 for jointly-owned technologies for which Stanford has licensing responsibility.

ROYALTY DISTRIBUTION



101 NEW LICENSE AGREEMENTS

504 NEW TECHNOLOGY DISCLOSURES

40% LIFE SCIENCES

60% PHYSICAL SCIENCES

EXPENSES

OTL spent $7.5M on patent and other legal expenses, of which $2.8M was reimbursed by licensees. We have an inventory of $18.1M, which represents patent expenses for unlicensed inventions. Our operating budget for the year (excluding patent expenses) was $5.4M.

We take a financial risk each time we decide whether or not to file for a patent. In this period of tremendous change in the intellectual property landscape as court cases determine new patent law, we will have to weigh the likelihood of licensing a technology versus the expense of patenting or litigation.

EQUITY

As of August 31, 2011, Stanford held equity in 109 companies as a result of license agreements. The market for initial public offerings was slow this year and share prices were down. For institutional conflict-of-interest reasons and insider trading concerns, the Stanford Management Company sells our public equities as soon as Stanford is allowed to liquidate rather than holding equity to maximize return. This year, we received equity from 8 start-up companies. We also received $2,398,738 in liquidated equity from 5 other companies.

START-UPS

While Stanford entrepreneurs are still starting companies, the uncertain economy clearly affects the Silicon Valley entrepreneurial ecosystem. Venture capital investors are generally shying away from early stage technology. Yet we licensed these companies: Biomimedica, C3Nano, KHYSS, Lex Machina, Personalis, Quanticell, Quantumscape, VENETO Pharma.

NEW DISCLOSURES

In calendar year 2011, we received over 504 new technology disclosures. Approximately 40% were in the life sciences and 60% were in the physical sciences, including computer science technologies and medical devices.

STANFORD TRADEMARK ENFORCEMENT FUND

The chief financial officer and general counsel of Stanford recommended that Stanford provide a permanent source of funding for extraordinary cases associated with the protection of the Stanford name and associated logos and trademarks. Based on their recommendation, the president and provost approved the creation of the Stanford Trademark Enforcement Fund (STEF). Funding for the STEF comes from 1% of the department and school shares of net revenue OTL receives. In 2010-11, we transferred $358,127 to STEF for a total to date of $2,982,933.

BIRDSEED FUND

The OTL Birdseed Fund, administered by the dean of research, has provided small amounts of money (typically up to $25,000) to fund prototype development or modest reduction-to-practice experiments for unlicensed technologies. This year, the Birdseed Fund funded two new projects, for a total of 87 projects funded to date. The rate of licensing of Birdseed-funded inventions is about the same as unfunded inventions (20-30%) but without this funding, many of these inventions would likely have remained unlicensed.

MTA POLICY

Stanford and OTL have been at the forefront of minimizing the bureaucracy and time-delays associated with Material Transfer Agreements (MTA), which govern the sharing of research materials with other research colleagues. In September, Stanford's Vice Provost and Dean of Research Ann Arvin obtained agreement from her colleagues that "collegiality, science, and sharing should take

precedence over commercial considerations" among researchers at academic and other non-profit institutions. In July 2010, Professor Arvin issued a formal message to faculty to encourage them to minimize the use of MTAs whenever possible. We think this is a significant initiative for the research community and hope that more universities adopt this practice.

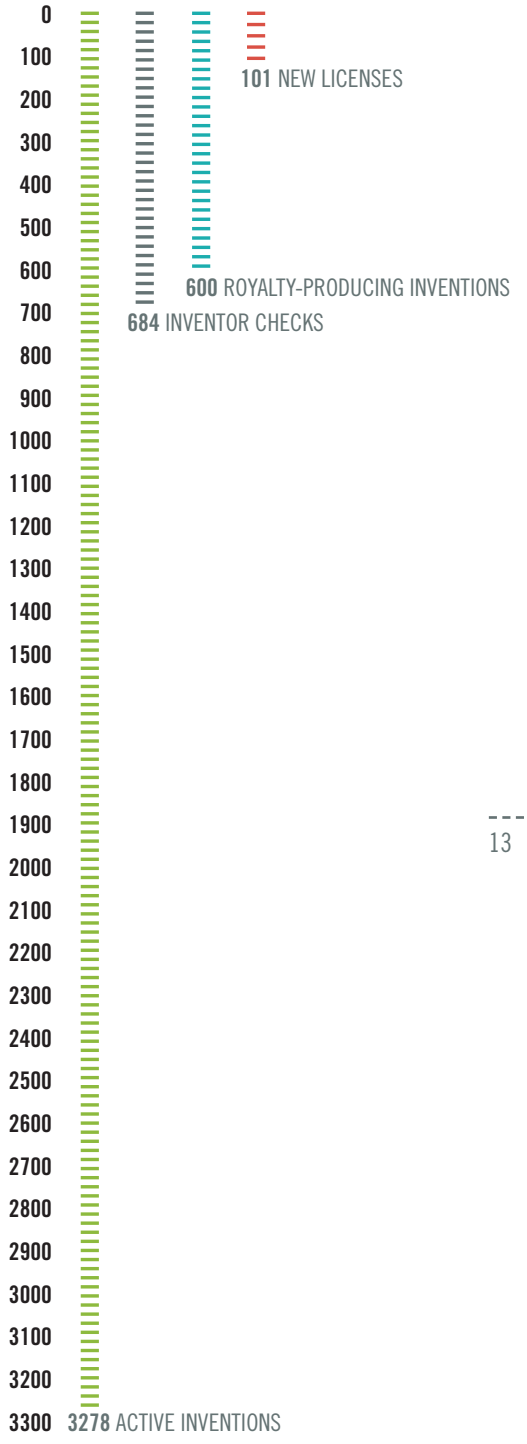
NATIONAL ACADEMY OF SCIENCES

Katharine Ku of OTL served on the National Academy of Sciences Committee that issued a report this year on "Managing University Intellectual Property in the Public Interest." It affirmed that IP-based technology transfer is squarely within the research university's core missions of discovery, learning and the promotion of social well-being, and the current system based on the Bayh-Dole Act is better than the pre-existing system. It also stressed that "patenting and licensing practices should not be predicated on the goal of raising significant revenue for the institution," which is consistent with Stanford's philosophy. The Committee also endorsed both the "Nine Points to Consider in Licensing" and the MTA Policy as described previously, both initiatives spearheaded by Stanford.

UPDATE ON THE ROCHE CASE

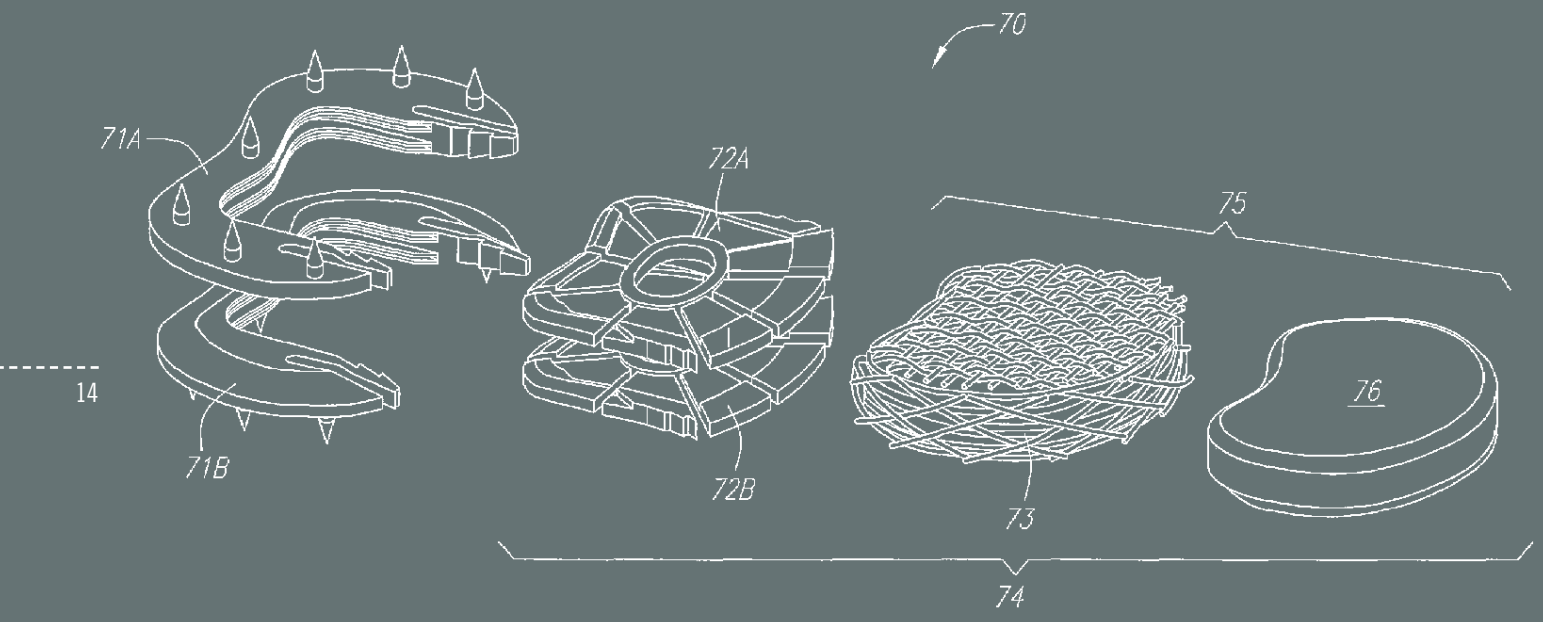
In October 2005, Stanford initiated a patent infringement lawsuit against Roche based on an patent issued to Stanford that enables clinicians to evaluate the efficacy of HIV retroviral therapy. Because of a decision by the Court of Appeals of the Federal Circuit, the controlling legal issue became the possible assignment of the patent rights by a Stanford researcher. Stanford, joined by the Federal Government and many university amici, and Roche argued their points before the Supreme Court in February 2011. The U.S. Supreme Court issued a ruling in June in favor of Roche based on its interpretation of Federal law. The ruling has had a far-reaching impact on the ownership rights to inventions that result from research funded by the federal government. http://news.stanford.edu/news/2011/june/court-roche-ruling-060711.html As a result, many universities, including Stanford, have changed their patent agreements with faculty, students and staff.

BY THE NUMBERS



GROSS ROYALTY REVENUE

$66.8M FROM **600** TECHNOLOGIES



Curt Frank, the W. M. Keck, Sr., Professor of Chemical Engineering and director of the Center for Polymer Interfaces and Macromolecular Assemblies, helped develop a synthetic replacement for the intervertebral discs in the spinal column. The patented technology, illustrated above, has been licensed by Spinal Kenetics, founded in 2003.

INDUSTRIAL CONTRACTS OFFICE

In 2010-11, the Industrial Contracts Office finalized about 1100 research-related agreements with for-profit and non-profit entities. Of this total, about 120 were new industry-sponsored research agreements. The School of Medicine accounted for just under half of these, with 54 sponsored research agreements, and the School of Engineering accounted for over one-third, with 43 new agreements.

As in other years, Material Transfer Agreements (MTAs) accounted for the largest share of ICO agreements with about 650 new MTAs for incoming materials and 55 outgoing MTAs; another 40 were outgoing human tissue transfers. About two-thirds of the incoming MTAs were with other nonprofit institutions and the federal government, and the rest were with companies. Most of the MTAs (about 520) were for researchers in the School of Medicine. The number of MTAs universities receive has proliferated in recent years, posing a barrier to scientific interactions. Since mid-2010, Stanford and several other universities and institutions have promoted a "no MTA" policy, under which universities and other nonprofits may transfer laboratory, non-human materials for research purposes without using an agreement. If an agreement is necessary, they use one of two well-known, standard MTAs whenever possible. As of Fall 2011, 25 institutions supported the policy and others were expressing interest.

Other ICO agreements included amendments to existing agreements, collaborations, equipment loans, NDAs, research licenses and other research-related agreements.

A wide variety of companies fund research at Stanford. Below is a sampling of agreements ICO negotiated during the year:

Varian

Professor James Ford of the Oncology Department in the School of Medicine is collaborating with Varian Medical Systems in pancreatic cancer research. Varian Medical Systems also signed a Master Research and Collaboration Agreement to fund projects on imaging, retrospective studies, clinical evaluations, and trials related to cancer research.

Google

Google provided funding for several projects in the Department of Computer Science. Professor Marc Levoy received funding for research on new directions in burst-mode photography. In this mode, several images can be captured with one press on the shutter. This is used mainly in mixed-light conditions or when the subject is in successive motion. Professor Levoy is researching two extensions of burst-mode photography, which could represent enormous opportunities, especially in the smartphone market. Google also funded Professor Andrew Ng's research on the development of parallel implementations of deep learning algorithms.

Sanofi-aventis

A Master Research Agreement was signed with Sanofi-aventis to establish collaboration on various research projects to advance knowledge in the area of human health and to develop therapeutic, diagnostic and prognostic applications. Projects from a number of different departments and schools are expected to be funded under the agreement.

Philips

Philips Medical Systems funded research in the School of Medicine. Professor Dimitre Hristov in the Radiation Oncology Department is developing and evaluating a second-generation

robotic manipulator enabling remote control 4D US imaging for real time guidance of radiotherapy beam delivery to treat the prostate, liver, pancreas and kidneys. Professor of Pediatrics David Stevenson also received funding from Philips Electronics North America Corporation to investigate the action wavelength spectrum of light to degrade bilirubin.

Givaudan Flavors Corporation

Givaudan Flavors Corporation funded Professor of Psychology Sam McClure's research on the influence of odor on consumer judgment and decision-making.

Eni

The Italian energy company Eni S.p.A. has sponsored five research projects under a Master Agreement. Two of these research projects are in the School of Earth Sciences under the direction of Professors Stephan Graham and Michael Moldowan. Both projects deal with hydrocarbon advanced characterization in an effort to define its origin and migration patterns. The Agreement also includes three environmental research projects focused on 1) developing new sensors for contaminants monitoring, 2) microbiology for bioremediation applications and 3) novel approaches to manage sediments based on contaminants bioavailability. Eni is also a member of several University Affiliate Programs - Smart Fields Consortium (SFC); SUPRI-B; the Stanford Earth Sciences Algorithms and Architectures Initiative (SESAAI), and the Stanford Exploration Project.

Industrial Affiliates Programs

During FY11, the University's 56 Affiliate Programs generated $25,765,743 in research funding, representing a 21% increase above the revenue total for the previous fiscal year.

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