EVOLVE

STANFORD OFFICE OF TECHNOLOGY LICENSING
ANNUAL REPORT FY2021

“CHANGE IS THE LAW OF LIFE.
AND THOSE WHO LOOK ONLY TO THE PAST
OR THE PRESENT ARE CERTAIN
TO MISS THE FUTURE.”

—JOHN F. KENNEDY
35TH PRESIDENT OF THE UNITED STATES (1961–1963)

Change has been an unavoidable theme of recent years, as societal shifts driven by the global pandemic have highlighted the importance of united public cooperation even as individuals were forced farther apart.

At the Office of Technology Licensing (OTL), the COVID-19 pandemic has highlighted the office's mission to ensure that Stanford technologies are transferred "for society's use and benefit" in an unprecedented fashion. Stanford researchers have embarked on projects with the potential to heal emergent physical, mental, and social ailments, and OTL has been on hand to serve in transferring these technologies to the broader community.

In the second year of the global pandemic, productivity at OTL has continued to rise to meet the demands of our colleagues across the university. The office has worked diligently to fulfill its mission and has put in place a record number of license and research agreements, even in the face of starkly fluctuating markets and under evolving circumstances dictating unfamiliar travel and working arrangements. After two years of remote work, a newly hybrid workforce has recently been able to reunite in person, fostering new connections among teammates and rebuilding old ones.

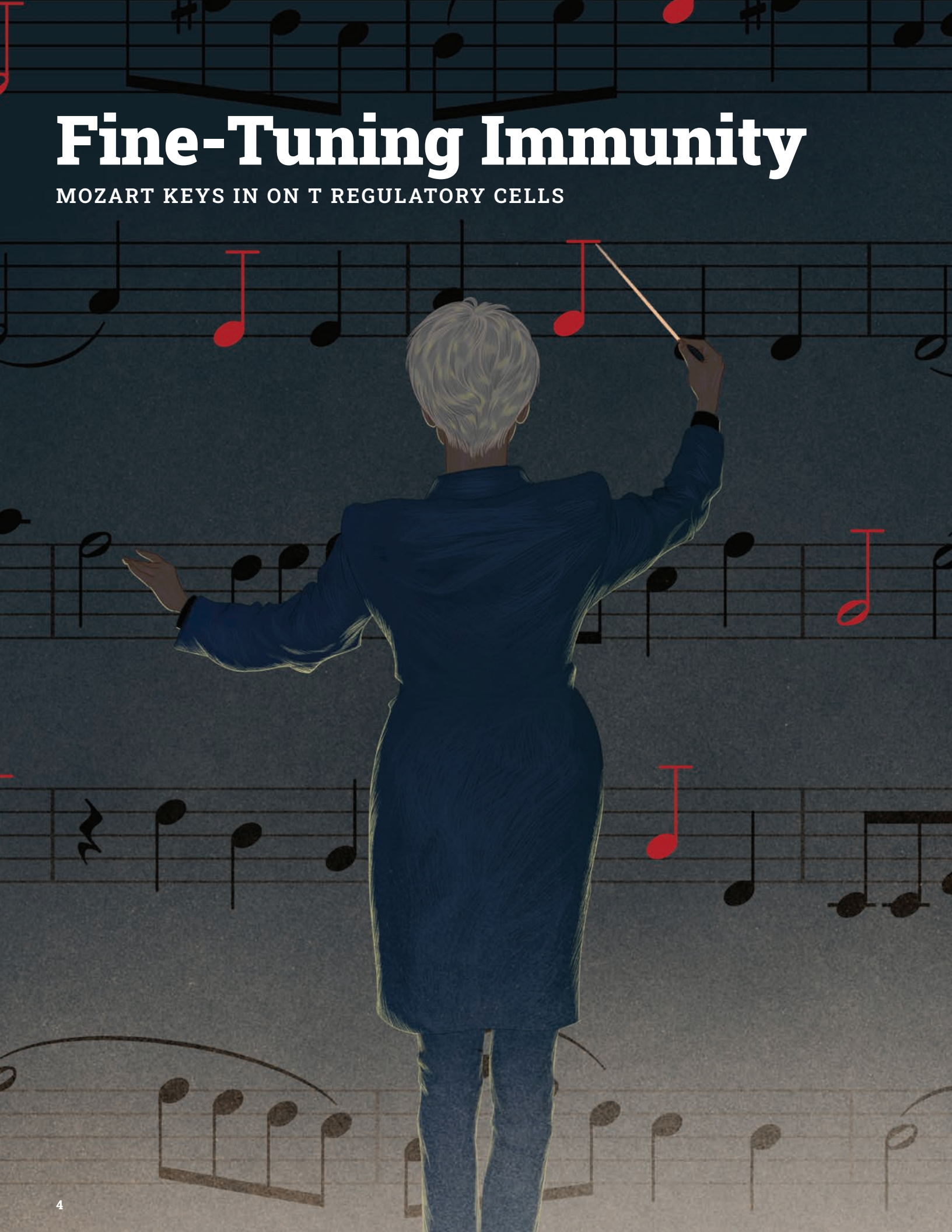
Outside of logistical changes brought on by the pandemic, OTL is also finding new ways to conduct business, pursuing fundamentally different transactions to help commercialize Stanford technologies and support Stanford researchers. As we promote further development and maturation of Stanford technologies on campus and transfer them within an increasingly complex innovation ecosystem, OTL is responding with deal structures that are more flexible than ever, enabling greater collaboration with diverse entities capable of providing new tools and support for Stanford researchers. Our expanding Strategic Alliances team has led the way in forging innovative new relationships and agreements to support initiatives like Stanford's Innovative Medicines Accelerator (IMA), in parallel with the Industrial Contracts Office building out a specialized Data Access and Transfer Agreements (DATA) team to manage the growing demand for research-enabling transactions involving data sets. Meanwhile, an expanding Business Development and Marketing group is working to achieve both broader outreach for Stanford intellectual property assets and closer collaboration with industry stakeholders in the hope of sparking new licenses and industry-sponsored projects.

Just as the business functions of OTL continue to evolve, so have the priorities of the Stanford researchers that the office aims to serve. Many projects were even empowered by the pandemic, as previously niche needs like distanced socialization or characterization of rare immune variants were brought to the forefront by COVID-19.

Evolution leaves subsequent generations stronger than the ones that preceded them, empowered to meet the next round of challenges. At OTL, we aim to embrace that opportunity.

Fine-Tuning Immunity

MOZART KEYS IN ON T REGULATORY CELLS



Researchers in Professor Mark Davis' laboratory have found themselves tuning into the activity of a tiny sliver of T cells, which they're hoping to orchestrate into a treatment for a variety of autoimmune diseases.

Activation of the adaptive immune system, and the T cells that mediate it, enables a strong defense against an ever-evolving army of infectious pathogens. However, this response can go awry in the context of autoimmune diseases, where T cells are instead responding to self-antigens and attack their host. T regulatory cells (Tregs) are a subtype of T cell that can apply a 'brake' to those immune responses, but a poor understanding of their activity has limited the development of therapeutics targeting the population.

In searching for a means to rein in these misdirected T cells, the Davis lab identified a subset of CD8 Tregs that selectively target the pathogenic CD4 T cells responsible for autoimmune responses- opening the door to potentially modulate their activity without causing broader immune suppression. Characterizing this network of CD8 Tregs was the seminal work licensed to startup Mozart Therapeutics, which is now building off of that foundation to explore multiple pathways to modulate the network and restore immune balance.

In addition to the expertise and research generated by Prof. Davis, the company is also capitalizing on the skill and guidance of Prof. Chris Garcia to engineer specific therapeutics, as well as organoid-based model systems from Prof. Calvin Kuo.

Mozart CEO Katie Fanning stepped in to lead the company on its mission to translate the findings from the Davis lab into disease-modifying therapies in autoimmune diseases. Given the foundational findings of the scientific founders and the novel approach in changing the treatment paradigm across autoimmune diseases, she found that the opportunity to support Mozart's mission was hard to turn down.

"When people hear that Mozart was built on the research and enabling technology generated by our founders, they sit up and listen," Fanning said.

Mozart will initially apply its platform to the development of biologics for autoimmune gastrointestinal disorders such as celiac disease, where there are no treatment options beyond onerous, lifelong diet modifications. Notably, the cell network identified in the Davis lab seems to be replicated across a wide array of autoimmune diseases, which suggests that therapeutics could be beneficial to a broad spectrum of patients.

"What was really important in launching Mozart was creating a company that is taking a truly differentiated approach and could potentially shift the treatment paradigm to make a meaningful difference in the lives of patients with autoimmune diseases," Fanning said.

Mozart is currently developing a lead candidate to treat celiac and other autoimmune gastrointestinal diseases, and anticipates clinical studies to begin in the next two years.

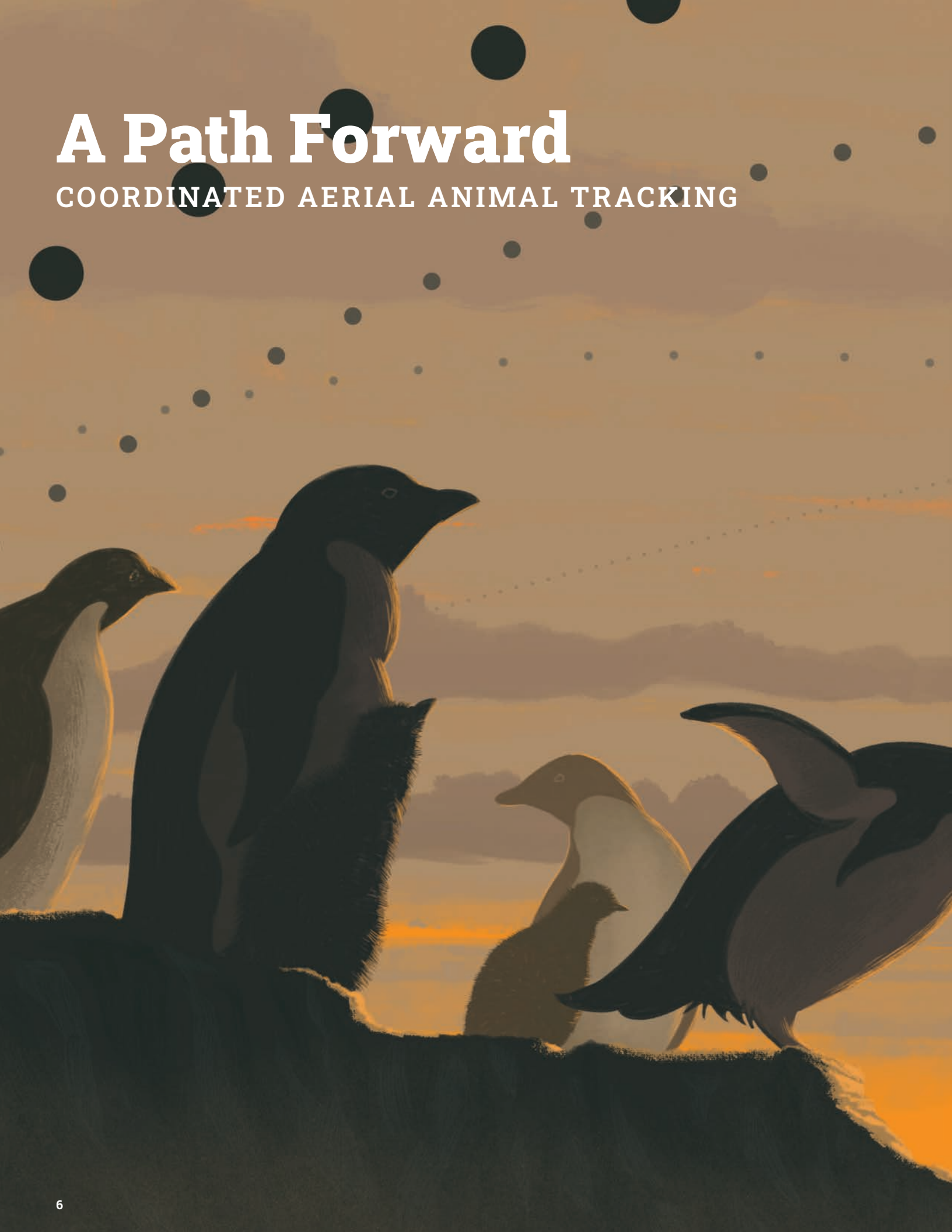
"It has been truly humbling to see the support this project has received, both inside and outside of Stanford, manifest into a new venture with the potential to impact patients," Prof. Davis said.

"It has been truly humbling to see the support this project has received . . . manifest into a new venture with the potential to impact patients."

—MARK M. DAVIS, PHD
Director, Stanford Institute For Immunity, Transplantation and Infection and the Burt and Marion Avery Family Professor

A Path Forward

COORDINATED AERIAL ANIMAL TRACKING



Monitoring wildlife can reveal deep truths about the vitality of ecosystems. But getting the big picture of a moving—or waddling—target is notoriously challenging.

Aerial surveys using helicopters can be expensive and disturb animals; a single drone can be time-consuming and tough to navigate. Innovators in Prof. Mac Schwager's lab have a solution.

They've developed a flightpath planning algorithm to coordinate not one, but teams of autonomous drones. Their system goes a long way towards solving the problem of finding routes over large-scale, challenging terrain—think ice sheet and mountains—to complete aerial survey tasks in dramatically reduced time.

Their proving ground in Antarctica was about the most remote imaginable. Kunal Shah, a graduate student in Prof. Schwager's Multi-Robot Systems Lab (MSL) at the time, helped lead the test deployment from a camp on frigid Ross Island. Their targets included several sites including one of the largest Adélie penguin colonies in the world, containing over 300,000 nesting pairs.

Previous human-piloted single-drone surveys required over two days to complete the task. The Stanford team, along with co-inventors Grant Ballard and Annie Schmidt from Point Blue Conservation Science, attained data for a detailed visual survey of the colony in under three hours.

While drone technology is widespread, "this was a case where really specific needs for biology and ecology weren't being met with commercial products," says Kunal Shah, who has since graduated from Prof. Schwager's lab.

Unlike existing methods that rely on battery-sucking, back-and-forth sweeping motions, the new system requires much less backtracking. It interfaces with ground control software by providing a set of routes that cover a desired area in common formats. These routes can be flown simultaneously.

Efficient drone surveys like these could be used to monitor everything from wildlife to wildfires. They could support better farm and ranch land management, and potentially lifesaving search and rescue operations.

Point Blue Conservation Science continues to use the technology, which recently completed its third successful Antarctic mission.

The system has been deployed over Mono Lake in California to survey a California gull colony, as well as a 2,000-acre ranch in the state. This work has been supporting additional surveys in all locations for three years running. Optimization efforts are still ongoing.

Shah is looking forward to seeing where the technology goes from here. Its potential application in the fight against wildfires is especially compelling.

"I've lived in California all my life, so it's an issue that is near and dear to my heart," he says. "To enable that sort of technology would be pretty amazing for me."

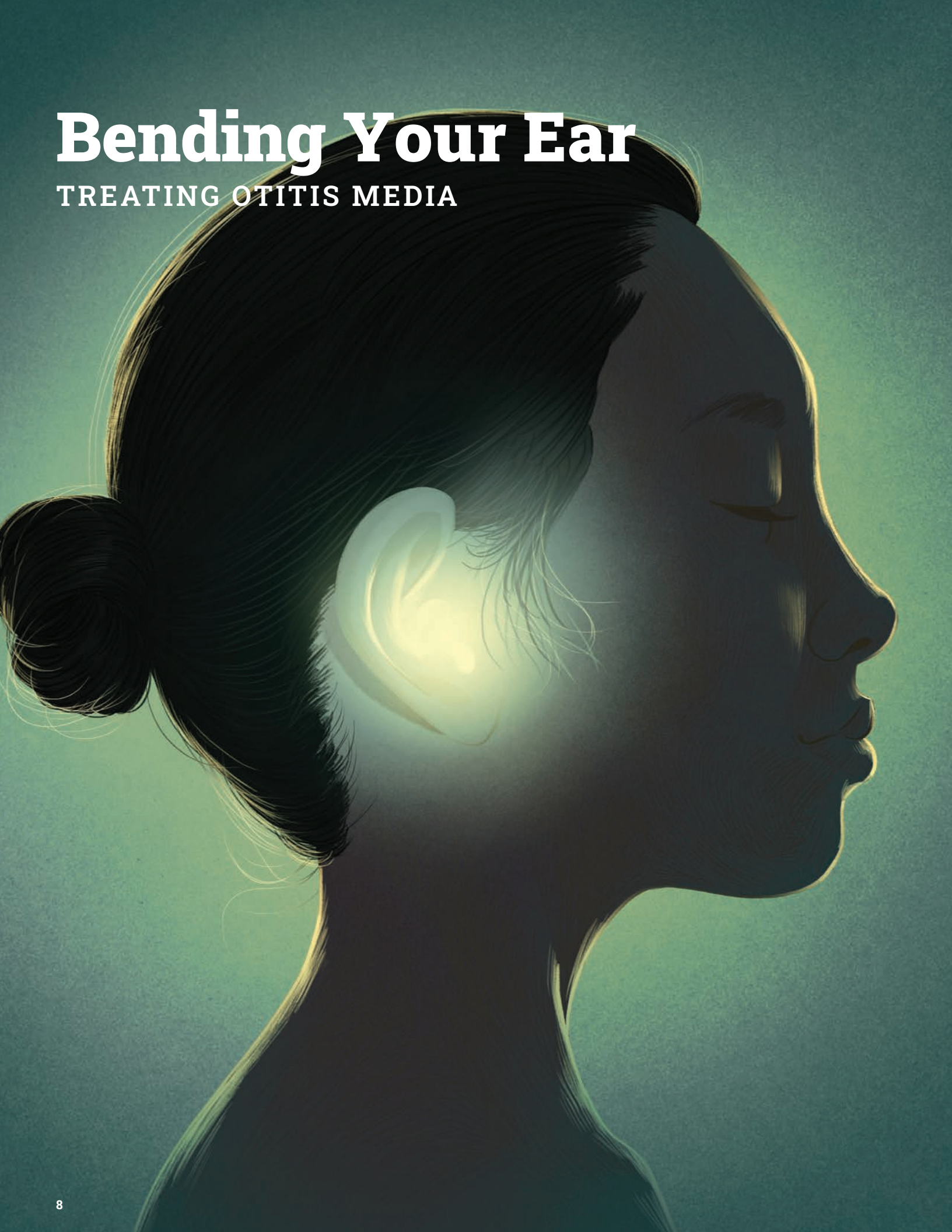
"This was a case where really specific needs for biology and ecology weren't being met with commercial products."

—KUNAL SHAH, PHD Mechanical Engineering, Stanford School of Engineering, 2021

ALL PHOTOS: ANNIE SCHMIDT/POINT BLUE

Bending Your Ear

TREATING OTITIS MEDIA



For hundreds of thousands of children a year, surgical intervention—and all of its complications—is the only effective treatment for a common ear condition. A group of Stanford researchers is developing a kid-friendly device to nip those surgeries in the bud.

Otitis media with effusion (OME) or 'glue ear' is a common disease in young children characterized by the buildup of fluid in the middle ear, which can cause hearing difficulties and even permanent hearing loss. When symptoms arise, there are few solutions short of an ear-draining surgery. This procedure is sometimes unavoidable, but is a stressful option for children and their parents, due to a small but not insignificant chance of serious complications.

OME is common in the US, but in certain global populations, like Aboriginal and Torres Strait Islander children of Northern Territories of Australia, a staggering 9 in 10 children are affected. This is where surgeon-scientist and Prof. Peter Santa Maria first encountered the condition as a visiting clinician in the remote Northern regions of Australia. "We'd see literally hundreds of kids a day," he recalled. "That's where the personal passion came from for doing this research."

The place and that passion would collide again when Prof. Santa Maria hosted Matthew Oldakowski and Jozef Bartunek for Stanford Biodesign's Global Faculty Training Program in 2018. Oldakowski, a fellow Perth native, and Bartunek, a Belgian visiting scholar, saw firsthand the impact of both the disease and its surgical complications while participating in the Biodesign program. This experience inspired them to work with Prof. Santa Maria and his colleague in the Division of Pediatric Otolaryngology, Doug Sidel, to find a new kind of solution—one that avoids surgery.

For that new solution they were inspired by an old one: a well-known mechanism for draining the inner ear by triggering the opening of the eustachian tube. For hundreds of years, people have experimented with this therapeutic route, with methods as uncomfortable as they were clever. More modern devices, while improved, require that young children manually coordinate swallowing with the application of pressure in the inner ear.

These tools lacked a means to make the ear-draining process both practical and comfortable for children, but the team devised a solution starting from a familiar household item—the sippy cup. Because kids swallow while drinking from the cup, it could be modified with a device that coordinates swallowing with a puff of air pressure- a simple and effective way to open the eustachian tube to drain fluid from the ear.

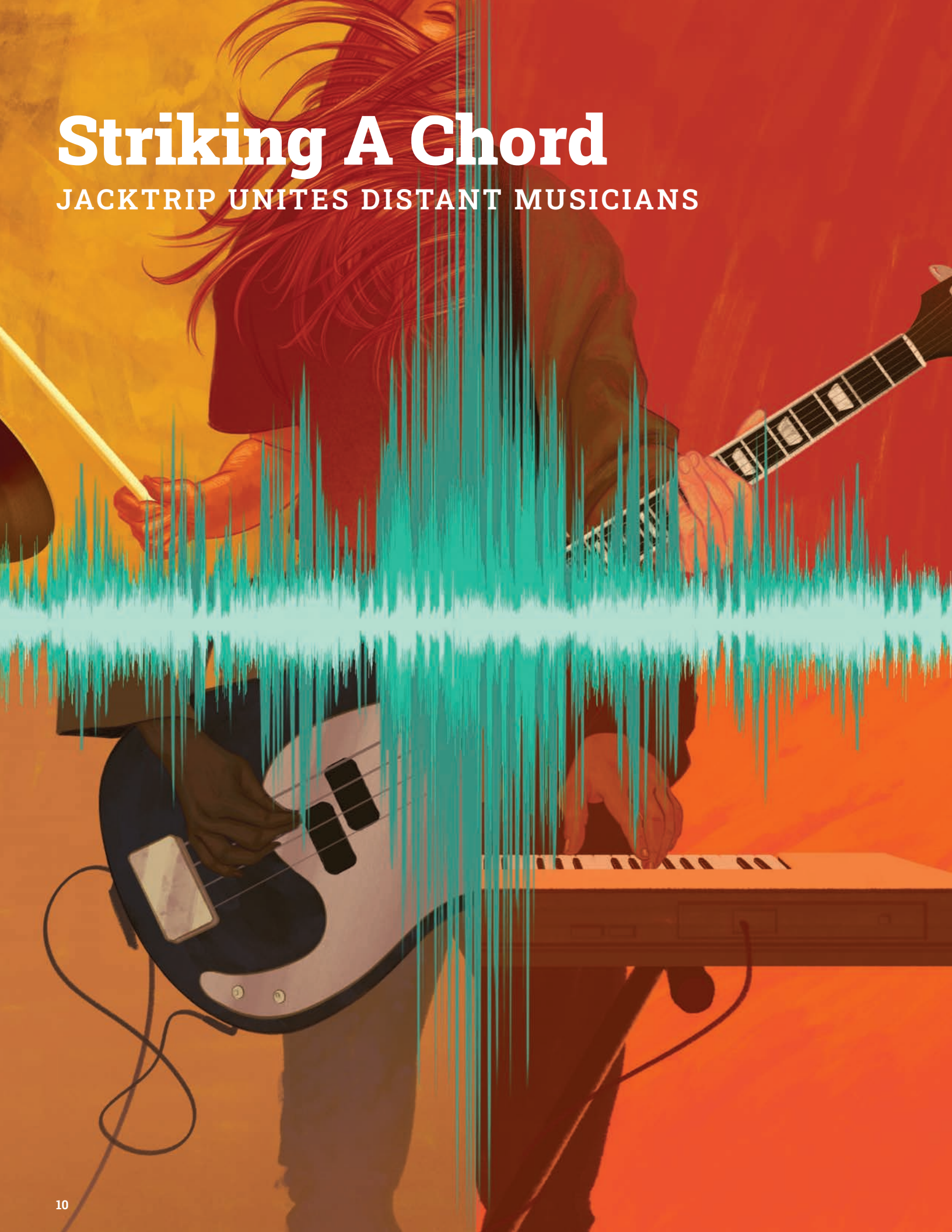
The success seen in early clinical trials with their prototype device has surprised even the inventors themselves, in some cases curing the affliction after only one use. Prof. Santa Maria credits the success to the team of global collaborators and to the "pipeline of support" that Stanford provided, including his department, Biodesign, the SPARK program, and guidance from OTL. "A lot of places you have an invention and then you have a gap," he says. "You can't do this in most universities because it's absolutely critical that you have a tech transfer office that is interested and supportive of inventors."

"We'd see literally hundreds of kids a day. That's where the personal passion came from for doing this research."

—PETER SANTA MARIA, MD, PHD
Associate Director , Stanford SPARK and Associate Professor, Otolaryngology, Neurotology and Skull Base Surgery

Striking A Chord

JACKTRIP UNITES DISTANT MUSICIANS



Whether it be classical orchestras or rock bands, music is often created and performed in collaboration with others. However, March of 2020 brought in-person musical collaborations to a complete halt with the onset of the COVID-19 pandemic.

"It got really lonely really fast and there was a lot of searching for solutions" said Prof. Chris Chafe, Director of the Center for Computer Research in Music and Acoustics (CCRMA) and Professor in the Department of Music.

While videoconferencing applications could support simple conversations, they weren't up to the task of playing music together with others over the internet. The problem was latency, the time delay in transferring data from one point in the network to the other. In normal conversation this increased latency isn't readily perceptible, but it can easily throw off the timing in musical performances.

"Everybody was trying videoconference and failing miserably to even sing 'Happy Birthday.' So how could you rehearse?" said Prof. Chafe.

Luckily, Prof. Chafe and colleagues had developed a solution: JackTrip, an open-source program for bidirectional, low-latency, uncompressed audio streaming. JackTrip enables the transmission of high-fidelity audio data with low enough latency that musicians can keep in sync with each other during performances.

JackTrip had originated twenty years prior as an outgrowth from a collaborative project on network quality. For most of its existence, it was mostly used for connecting university music groups in different countries over speciality high-speed networks. Over time, Prof. Chafe and colleagues realized that improved internet speeds had gradually made implementing JackTrip for the average person feasible. Then the COVID-19 pandemic struck, and musicians everywhere desperately needed a way to connect with each other remotely, so the team got to work.

JackTrip had to undergo several changes to make it work over home internet connections and to improve its user-friendliness. The original version of JackTrip connected each user on the network to the other, which increased the demand on the network exponentially with each additional connection. To solve this issue, JackTrip now uses a 'hub-and-spokes' model on a centralized server. Prof. Chafe and colleagues also added a more user-friendly graphical user interface (GUI), and adapted JackTrip to run on Mac and Windows operating systems. A hardware-only version of the system is even affordable to lay users, with an open-source version of JackTrip for Raspberry Pi computers available for under fifty dollars. In addition to enabling countless musical groups throughout the pandemic, such as the Bay Area's renowned Ragazzi Boys Chorus, Prof. Chafe and the CCRMA have continuously hosted 'Quarantine Sessions' that uses JackTrip to bring musicians together from Stanford, Germany, and Belgium to jam out weekly.

"There's been a lot of folks saying how JackTrip provided a means to continue music. If you're able to connect to somebody else and it feels like you're together . . . That's the joy of music," said Prof. Chafe.

Prof. Chafe has co-founded the JackTrip Foundation, which supports innovation and adoption of the network arts through grants, education and community building, and JackTrip Labs, which offers a commercially supported cloud-based platform. They have helped thousands of musicians and hundreds of organizations worldwide continue making music together throughout the pandemic.

PHOTO: BRADEN KOWITZ

"If you're able to connect to somebody else and it feels like you're together . . . That's the joy of music."

—CHRIS CHAFE, Duca Family Professor of Humanities and Sciences, Director of the Center for Computer Research in Music and Acoustics (CCRMA), Professor in the Department of Music

Year in Review

LICENSING FACTS AND FIGURES

In FY2021, Stanford received $118M in gross royalty revenue and equity from 1,102 technologies, with royalties and equity ranging from $13 dollars to $35.5M dollars. Twelve inventions received $1M or more in royalties or equity, and 58 technologies generated between $100,000 and $1M.

While there was a slight increase in the number of dockets that brought in $1M more in FY2021, more than 90% of our technologies generate less that $100,000 in royalties and are major contributors to the steady royalty base for Stanford. 561 technologies generated between $1,000 and $10,000 in royalties or equity in FY2021, while 298 technologies generated between $10,000 and $100,000.

We evaluated 493 new technology disclosures and signed 164 new licenses. 79 of the licenses were nonexclusive, 44 were exclusive and 41 were option agreements. There were 25 new startups based primarily on Stanford technology that received an option or license in FY2021.

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 $18.3M to 1,117 inventors. Stanford departments received $16.0M and schools received $14.1M after the University assessed an infrastructure charge on their shares of royalty income. Stanford also paid 37 other organizations $3.4M for jointly-owned technologies for which Stanford has licensing responsibility.

EQUITY

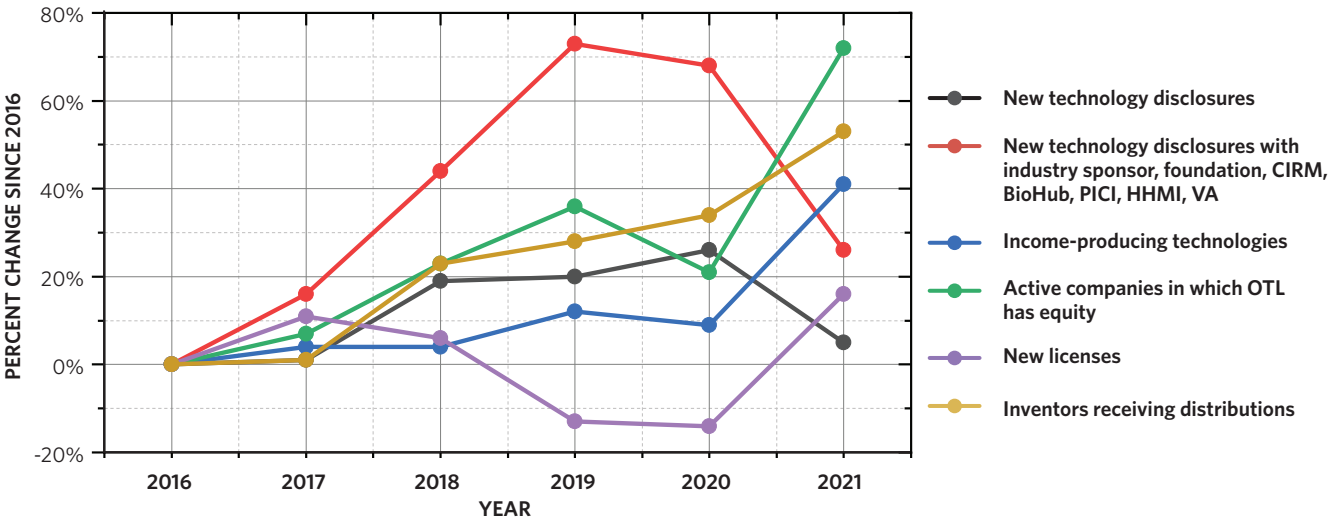
As of August 31, 2021, Stanford held equity in 256 companies as a result of a license agreement. During FY2021, equity from 22 companies was liquidated, generating $51.9M. Stanford normally sells securities acquired as part of the licensing process promptly after they become freely tradeable on public markets. In FY2021, we signed licenses that include equity with 23 companies.

$118M
IN GROSS ROYALTY REVENUE FROM
1,102
TECHNOLOGIES

58
TECHNOLOGIES GENERATED
$100,000–$1M
IN ROYALTIES OR EQUITY

12
TECHNOLOGIES GENERATED
$1M OR MORE
IN ROYALTIES OR EQUITY

FIG. 1: LICENSING TRENDS



The figure above shows trends for OTL-Licensing over 6 years, with the ratio of change relative to 2016.

493
NEW TECHNOLOGY DISCLOSURES

164
NEW LICENSE AGREEMENTS

79
NON-EXCLUSIVE

44
EXCLUSIVE

41
OPTION AGREEMENTS

25
AGREEMENTS WERE WITH STANFORD STARTUPS

"Strategic alliances are important because society's problems are so complex. No entity by itself can find solutions."

—SUNITA RAJDEV
Director for Licensing and Strategic Alliances, Life Sciences

STRATEGIC ALLIANCES NEWS

The past year featured several high-profile agreements with life science companies to advance Stanford innovation. OTL's Strategic Alliances team worked with groups like ICO and the Office of the General Counsel (OGC) to execute the deals, which include a major collaboration with a healthcare investment firm, and significant collaborations involving translational research through Stanford's Innovative Medicines Accelerator (IMA).

Managing high-potential partnerships like these is the mission-critical role of Sunita Rajdev, Director for Licensing and Strategic Alliances, Life Sciences.

Rajdev joined OTL in December 2019 to take the lead on agreements like these, which are challenging to navigate but offer great opportunity to facilitate transfer of innovative Stanford technologies from bench to bedside. In her role, she is charged with cultivating strategic research collaborations with both non-profit and for-profit entities as well as overseeing the management of resulting IP and licensing opportunities.

While the position is relatively new for OTL, it has deep roots. "Many universities these days have an alliance management function. But there are few that have the broader structure of strategic alliances. Our goal is to create alliances that harmonize the vision of the university and industry, and create an agreement that translates that vision into reality through a win-win deal for both parties." This broad approach is key to tackling convoluted problems, she says.

"Strategic alliances are important because society's problems are so complex. No entity by itself can find solutions."

This year's strategic agreements include:

- Multiple academic laboratories at Stanford can access Twist Bioscience's innovative antibody discovery services as well as its unique "Library of Libraries" through IMA for biologics discovery. There's also an option for researchers to engage Twist in their discovery and optimization work.
- Stanford entered into an agreement with Alloy Therapeutics under which IMA will support translational research projects to develop antibody prototypes by providing access to proprietary immunocompetent Alloy-Gx transgenic mice.
- Stanford and Deerfield Management, a health care investment firm, created the Porter Alliance for Innovative Medicines to accelerate translational research. This includes a commitment from Deerfield of up to $130 million and additional scientific and operational support, with a focus on drug prototypes emerging from Stanford's IMA.

Looking forward, Rajdev sees the Strategic Alliances group serving a more comprehensive role across the university, acting as a one-stop shop to match industry technologies with the needs of Stanford researchers, while also forging novel and creative alliances necessary to carry new advances all the way to commercialization.

"We are really evolving the tech transfer function to expand our reach into the university. The sky's the limit—we're just scratching the surface," Rajdev said.

ICO DIRECTOR'S NOTE

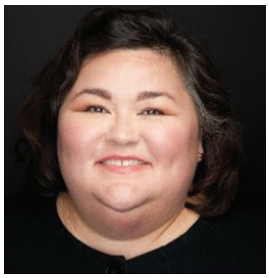
The Industrial Contracts Office supports Stanford research by negotiating and signing research-related agreements with industry sponsors and collaborators. ICO is responsible for a variety of types of contracts, including Sponsored Research, Material Transfer, Data Use, and Collaboration Agreements, among others. In addition, ICO manages agreements and approvals for over 60 affiliate programs.

This year, in partnership with Stanford's Office of Research Administration (ORA), ICO co-launched a new Data Access and Transfer Agreements (DATA) team focused on the increasing number of agreements to provide researchers with data critical to research. Researchers and administration at Stanford expressed a need to streamline and strengthen our ability to share data, mitigate risk, and maintain individual privacy while doing so. The DATA team, consisting of members from both ICO and ORA, is designed to streamline the process of negotiating agreements to share data with industry, government, and nonprofit researchers across the world.

In the past year, ICO faced challenges, like the rest of the world, due to COVID-19. We adjusted to working at home, lost a few valued team members to other endeavors, and welcomed new staff to our ranks. Despite the challenges, we negotiated and advised on a record number of agreements in all subject-matter areas for all seven of Stanford's schools and numerous institutes. We also worked with the Strategic Alliances team within OTL to complete several complex, long-term agreements with key industry partners and faculty. ICO also provides expert counsel and policy advice on intellectual property provisions in non-industry contracts to our internal partners within Stanford, and assists with requirements for compliance with federal reporting regulations.

It has been a busy, difficult year for our team, but we look forward to creating new solutions to problems and continuing to contribute our growing expertise as contracting officials representing Stanford's research community.

Glennia R. Campbell
Director, Industrial Contracts Office



GLENNIA R. CAMPBELL, DIRECTOR, INDUSTRIAL CONTRACTS OFFICE

ICO FACTS AND FIGURES

The Industrial Contracts Office (ICO) is a group within OTL that specializes in research agreements with industry. In FY2021, ICO finalized a total of 172 new industry sponsored research agreements (SRAs) where companies fund and sometimes collaborate on research projects at Stanford and 195 amendments to existing SRAs.

The School of Medicine accounted for more than half of these agreements with 90 new industry-funded research agreements. The Department of Medicine was home to the largest number of new industry research agreements, with 90 new SRAs. The Pathology Department in the School of Medicine had 13 new SRAs, Radiation Oncology accounted for 11, Radiology accounted for 10, and Pediatrics had 8 new SRAs.

The School of Engineering accounted for one third of the total SRAs, with 54 new industry-funded research agreements and 62 amendments to existing SRAs. The Computer Science Department was home to the largest number of new Engineering industry research agreements, with 14 new SRAs; Chemical Engineering had 8, Mechanical Engineering had 8; Aeronautics and Astronautics accounted for 6; and Materials Science and Engineering accounted for 6 new SRAs. ICO provided expertise and guidance on intellectual property terms and Stanford policy to faculty, staff and partner organizations on an additional 353 transactions in FY2021.

INDUSTRIAL AFFILIATES PROGRAMS

ICO also handles Industrial Affiliates Program approvals, renewals and related agreements. During the year, 64 programs brought in a total of $36.6M. SystemX in the School of Engineering continued to be the largest program, with $6.2M in funding.

Four new Affiliates Programs were approved in the past fiscal year:

- School of Medicine
  Precision Mental Health and Wellness
- School of Education
  EdTech
- School of Engineering
  Stanford Center at the Incheon Global Campus
- Office of the Vice Provost and Dean of Research
  Human-Centered Artificial Intelligence Corporate Affiliate Program

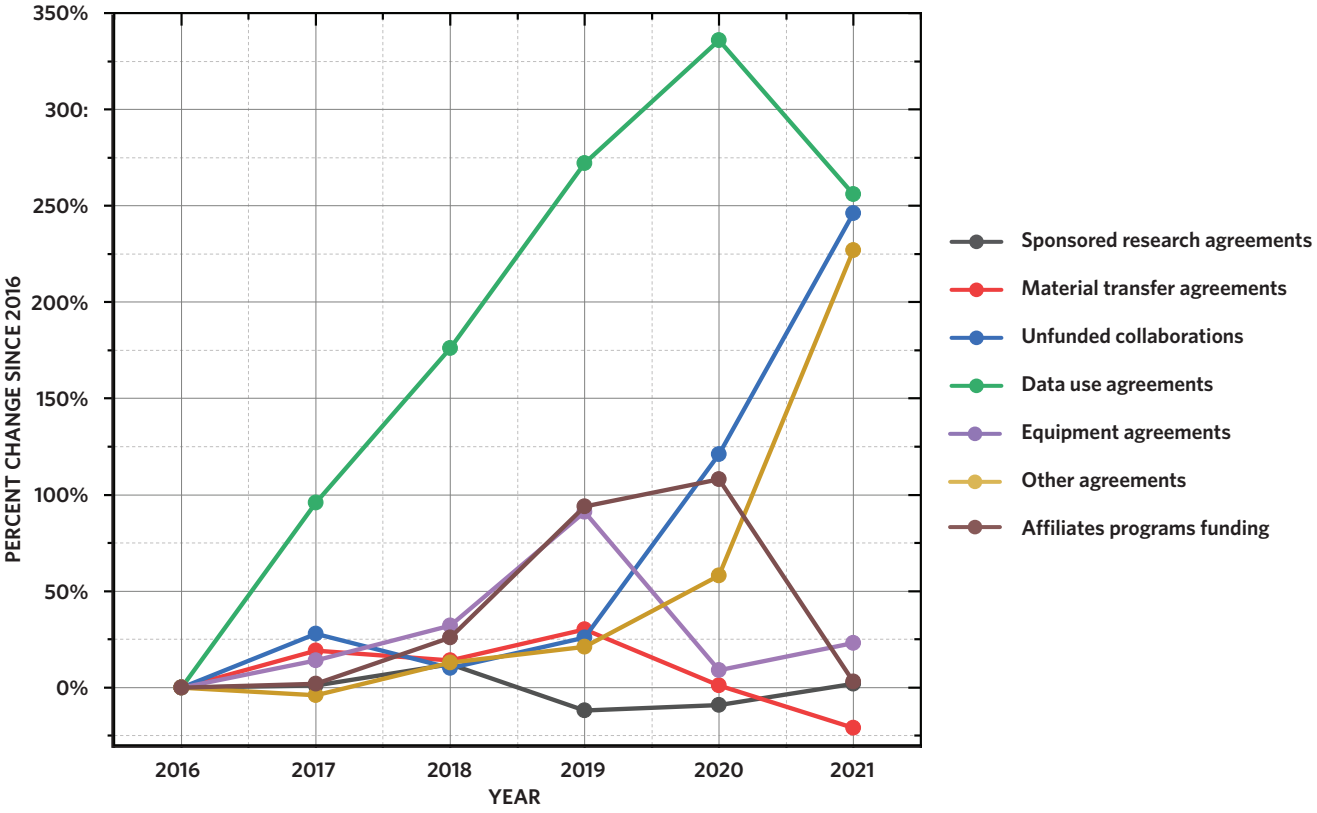
All in all, ICO finalized 1,865 agreements in FY2021. This includes 488 Material Transfer Agreements (MTAs); 87 Human Tissue Transfer Agreements; 135 Unfunded Collaborations; 89 Data Transfer Agreements; 27 Equipment Loans and a variety of other research-related agreements with companies.

172
NEW INDUSTRY-SPONSORED RESEARCH AGREEMENTS

64
AFFILIATES PROGRAMS BROUGHT IN
$36.6M

4
NEW AFFILIATES PROGRAMS WERE APPROVED

FIG. 2: AGREEMENT TRENDS



The figure above shows trends for ICO over 6 years, with the ratio of change relative to 2016.

ICO FINALIZED

1,865

NEW AGREEMENTS

488

NEW MTAS

89

DATA TRANSFER AGREEMENTS

OTL offers its sincere thanks to the innovators in the Stanford community who offered their time and guidance to contribute to this year's Annual Report.

This report gained from the contributions of many hard-working OTL-ers, especially the Annual Report Planning Committee: Ying-Li Chen, Evan Elder, Scott Elrod, Karin Immergluck, Chelsea Longwell, David Mallin, Jonathan Mares, Caroline Massee, Duyen (Dee) Thi Nguyen, Becky Simon, Chris Tagge, and Sally Younger.

otl.stanford.edu
ico.stanford.edu/
Twitter: @StanfordOTL
LinkedIn: linkedin.com/company/stanfordofficeoftechnologylicensing

Stanford University
Office of Technology Licensing
415 Broadway Street, 2nd Floor, MC 8854
Redwood City, CA 94063
Phone: (650) 723-0651

DESIGN BY ARTEFACT DESIGN | ILLUSTRATIONS BY MICHAEL MARSICANO