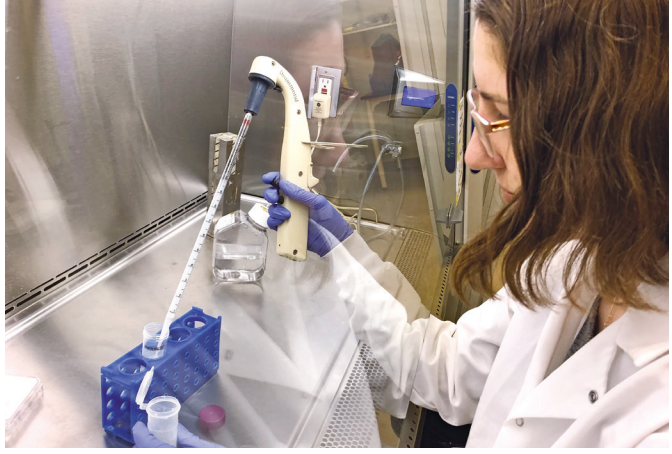
DRUG DELIVERY

Engineering breast milk to treat infant illness

Katie Whitehead's ambitious plan? Harness breast-milk cells to deliver drugs to babies

MEGHA SATYANARAYANA, C&EN DALLAS



After a morning visit to a local goat farm, Rose Doerfler processes the milk to isolate cells. The cells will be used in preliminary experiments to help build a system for breast milk as a drug-delivery vehicle.

CREDIT: MEGHA SATYANARAYANA/C&EN

Elsie is a consistent producer. Ebony is pretty hit or miss. But Charlotte—black and tan, with the perkiest ears—she's prolific. She's one reason why, every few weeks, a graduate student named Rose Doerfler wakes up at the crack of dawn to drive the winding roads outside Pittsburgh to Goat Rodeo Farm and Dairy.

On this December morning, Doerfler will gather milk from the capricious caprids of this cheese-making farm, rush back to Katie Whitehead's lab at Carnegie Mellon University, and carefully isolate the cells that float in the white, fatty murk.

"I'm optimistic," Doerfler says. "Charlotte did pretty well for me last time."

What Doerfler does with this milk is the first step in Whitehead's grand plan to one day turn human breast milk into a drug-delivery device for sick babies. The goat milk will serve as a model for human milk, with mice as a model for babies. She'll track goat-milk cells as they enter a mouse and do experiments to see if the cells can carry therapeutic payloads.

If this sounds kind of out there, Whitehead wants it that way. After the sting of having a grant rejected in 2016 because her ideas were "not innovative," she decided to prove the reviewer wrong. While nursing her infant daughter, she thought about what breast milk was and what it was giving her child. From there, the idea came into focus in bits and pieces.

Cell engineering is changing the way we treat disease, she thought. Look at cancer treatments that involve modified T cells. Human breast milk is full of cells. Surely, she thought, we can isolate them, engineer them to become potent vehicles for medicine delivery, and feed them to babies quickly and efficiently. Less poking and prodding, she thought, and less pain.

Coupling modern medicine to this most intimate and iconic act of motherhood could lead to a new wave of therapies and oral vaccines, she says in her grant proposal. Whitehead believes that she can engineer immune cells in breast milk so that they can deliver vaccines, or engineer stem cells in breast milk to fix certain birth defects. She could also engineer epithelial cells in breast milk to coax them into producing proteins that some babies cannot make, offering what could be a lifelong fix for some serious genetic diseases. For instance, in phenylketonuria, babies lack an enzyme that breaks down phenylalanine. The project could also help answer a slew of questions about the biology of breast milk and infant feeding.

The idea was a winner. In 2018, Whitehead, a chemical engineer who studies drug delivery, earned a National Institutes of Health Director's New Innovator Award to apply cell-engineering principles to breast milk. Finally, she was being recognized for big, bold thinking. And yet she wondered: Breast feeding is one of the oldest acts of humanity. Why are these questions bold? By 2018, shouldn't we already know what breast milk is capable of doing?

"The basic biology isn't revolutionary. It's there, waiting to be discovered," Whitehead says.

She wondered whether it hasn't yet been explored because, historically, women haven't been in leadership positions, applying, as scientists often do, their life experiences to their work. "I think it's because the women aren't doing the science. I really think that's the unfortunate answer."

Whether this project succeeds or fails, Whitehead says she hopes to get across that this is the tip of the iceberg when it comes to unanswered questions about female biology. She also hopes to encourage more women to let personal experiences shape our pursuit of science. This diversity in thinking will lead to broader questions, more discovery, and, of course, more innovation.

"I'm in my sixth year now of being a professor, and in the beginning I kind of thought, 'OK, I have to work on certain types of problems and certain types of diseases.' I have found it to be only somewhat fulfilling," she says as she waits to hear from Doerfler about the goat-milk cells she isolated that morning. "So to feel like there's this additional level of meaning that I can bring to my work—it's been really priceless."

First, follow the cells

Breast milk is a combination of carbohydrates, fats, proteins, nucleic acids, microbes, and a surprising number of cells from the woman who produced it. Carlito Lebrilla, an analytical chemist at the University of California, Davis, calls it "nature's delivery device." He's been parsing the oligosaccharide components of breast milk for years and learning how pervasive milk compounds are in a baby's body. "We've looked at the blood of infants, the urine of infants, the saliva, the stool—and the components of milk are everywhere," he says.

Lebrilla's efforts to track the molecular components of breast milk are akin to what Whitehead is trying to do with cells. She wants to know: Where do the cells from breast milk go in a baby's body? Babies' stomachs are less acidic than adults', and their immature digestive tracts are leaky enough for cells to slip through.

Armed with information about where breast-milk cells go in an infant's body, Whitehead says, she may be able to devise organ-specific treatments. She envisions taking breast milk from a mother with a sick child, isolating the cells, transfecting them with DNA corresponding to therapeutic proteins or vaccines, allowing the cells to grow and divide, then putting them back in the milk, and

feeding that medically fortified milk to the child. Evidence with other cell types in breast milk suggests that it's possible that these treatments could be lifelong—breast-milk cells can integrate into the organs of the child drinking them.

"My vision for them has been that they will essentially be protein-replacement factories. Epithelial cells are literally protein-production factories, so why not use them as such?" she says.

Of the three main types of cells found in human breast milk—epithelial, immune, and stem—Whitehead and her team are starting their experiments with epithelial cells, which line our organs and blood vessels. As the most abundant, they seemed like a good first choice to engineer.

This is where Charlotte, Elsie, and some of their sisters come in. One of Doerfler's first tasks in Whitehead's lab was to find a substantial source of breast-milk cells to study. Working with human breast milk would require complex protocols and ethics approvals, and it would be hard to develop a standard set of cells because humans vary in their diet and medication use. So Doerfler needed to look elsewhere.

Although mice make good test subjects for her work, including testing engineered cells in later experimental stages, "you can't get very much milk from mice," Doerfler deadpans.

After calling several farms just outside Pittsburgh, she learned about Goat Rodeo. Owner India Loevner was intrigued.

"People don't realize how closely related mammals who make milk are," Loevner says.

Loevner agreed to participate, and Doerfler began her periodic trek to the farm to collect samples during the morning milking session. She soon learned that a goat whose milk makes delicious cheese isn't always going to be the same goat that produces a lot of cells in its milk.

Back in the lab after that morning trip in December, Doerfler spun Charlotte's milk in a centrifuge and skimmed off the fat. At the bottom of the centrifuge tube was a thick layer of cells. She was pleased. As winter settled on southwest Pennsylvania, she got to work counting the cells so she could plan an experiment to put fluorescently tagged nanoparticles in them that would eventually help the lab track where the cells go.

"These look nice," she says, pointing to plump little blobs under a microscope on a counting grid.

Tracking breast-milk cells after they've been fed to an animal is not without precedent. Immune cells from breast milk have been found in the liver and spleen, among other places. And several years ago, Foteini Hassiotou Kakulas, a cell biologist at the University of Western Australia, tracked the movements of stem cells from human breast milk in the body of a mouse.

Where the cells journeyed in the body was surprising. "We are not just talking about easy-to-access organs, but also isolated and well-protected organs such as the brain," Kakulas says. "They integrate and become part of the normal function of these organs. It's an amazing phenomenon."

Kakulas also discovered that breast-milk cells, predominantly the epithelial ones, produce large amounts of a specific type of RNA that prevents messenger RNA from being translated into a protein. These RNAs largely control maternal genes. But Kakulas thinks that they, like most other elements of breast milk, have a mission inside a baby—influencing newborn and infant development by tamping down protein production related to, for example, thirst or hunger (*Int. J. Mol. Sci.* 2016, DOI: 10.3390/ijms17060956).

Kakulas sees a lot of potential in Whitehead's idea, but also a lot of risk.

"Breast-milk-cell research using modern techniques is relatively new and has a lot of promise in the medical field," she says. But "a lot of work will be required to ensure the safety of such a system in babies. Preterm babies and babies at risk are likely wonderful candidates in a research area such as this."

Lebrilla agrees that the idea is exciting.

"Milk is just an incredible resource for interesting particles and delivery devices, and I think people should really look at it more closely."

Second, get more women in science

For Whitehead, one of the side effects of the work she's put into the New Innovator Award has been a reckoning about the direction of her lab's focus. Before breast milk, her lab worked on drug delivery in a more general way, focusing on designing proteins for oral delivery or finding ways to transport RNA therapeutics. That work, she says, was less viscerally related to personal experience.

But with the breast-milk proposal, as well as another in the lab exploring how to package drugs in such a way that they can't cross the placenta, there has been a subtle shift toward addressing major problems that affect women's health during their reproductive years.

The experience of pregnancy, childbirth, and breastfeeding has laid bare for Whitehead the difficulties of doing research on pregnant women, fetuses, and children. Take the placenta project: most drugs have not and—with currently available technology—cannot easily be tested for fetal safety. Many pregnant women must make choices about taking medicines they might need without knowing if those medications are safe for their babies.

"Yes, it is absolutely true that there are very limited means by which to conduct ethical trials of any kind on this," she says of drug safety during pregnancy. But the people with the most institutional power are men, who underestimate the problem because they haven't experienced it themselves, she contends.

"I think the other large part of the problem is that there are a bunch of male scientists sitting around saying, 'Nobody's dying here,' " she says, so the quality-of-life issue gets lost.

Lebrilla says a broader cultural shift needs to happen in biomedical science for research on underserved topics like breast milk to become more pervasive.

"Certainly, I think having more women in science will change it in a big way," he says. But the problem is a bigger one of where we place our value. Biomedical science is focused on cures, he says, and less on prevention. And the messengers of prevention, the primary care doctors, the nurses, the dietitians, tend to be women. The work of prevention ends up being devalued, he says. And while Whitehead wants to cure disease, she wants to do it at the earliest point possible, through breast milk, or maybe formula, which the child would be getting anyway. In doing this, she hopes to prevent illnesses that often lead to disability or death, or prevent children and their families from having to go through years of painful and potentially costly treatments.

And so Charlotte, Elsie, Ebony, and the sisterhood of Goat Rodeo Farm find themselves part of not just a scientific project but a social one as well. Whitehead hopes that understanding more about breast milk and other aspects of women's biology will normalize women's biology as a space where chemical engineering can solve problems, but she doesn't believe that failure will kill that vibe.

"I believe the breast-milk proposal will serve 100% of the population," she says. "Everyone is born. Everyone has the potential to use this type of therapy. Our main goal is to create new technology that works. And so, even if I fail, if I can inspire others to go forth and to start asking questions along these lines, then it's a win, regardless of what happens to me." ■

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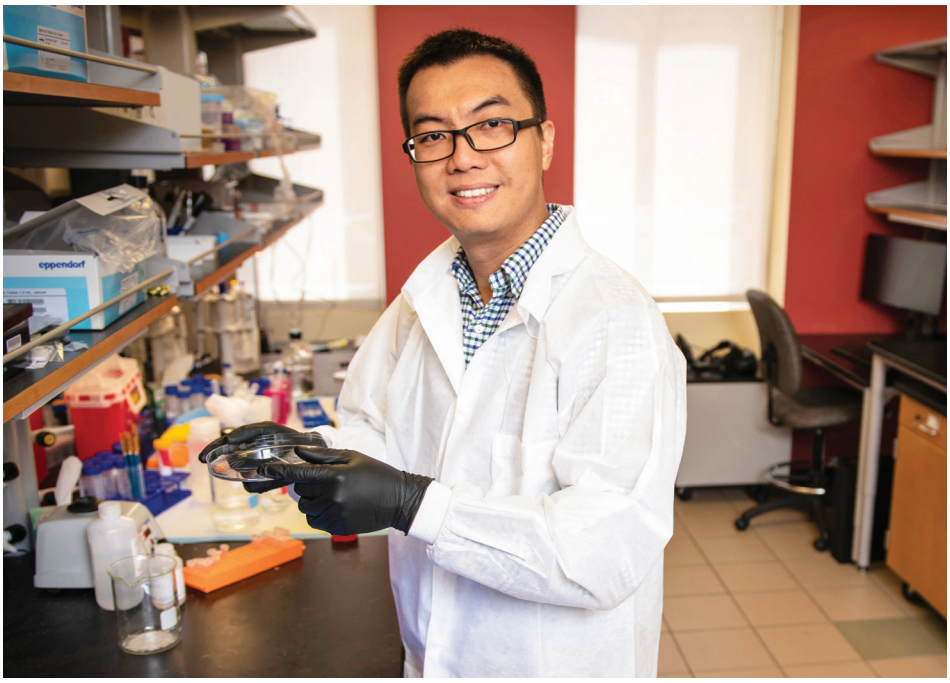
Microscopy And VR Illuminate New Ways To PREVENT AND TREAT DISEASE

JUNE 13, 2019

A combined research team from Carnegie Mellon University and Benaroya Research Institute (BRI) at Virginia Mason is pairing a nanoscale imaging technique with virtual reality (VR) technology to create a method that allows researchers to "step inside" their biological data.

By combining the technique, called expansion microscopy, with VR, scientists will be able to enlarge, explore and analyze cell structures far beyond the capabilities of traditional light microscopy.

The development of these technologies, a two-step process funded with $200,000 from Bill & Melinda Gates Foundation's Grand Challenges, will accelerate researchers' understanding of infectious and autoimmune diseases and enhance their ability to develop disease diagnostics and prevention and treatment methods.



Assistant Professor of Biological Sciences in CMU's Mellon College of Science Yongxin (Leon) Zhao is developing a microscopy technique that allows researchers to analyze cell structures in greater detail.

Yongxin (Leon) Zhao, an assistant professor of biological sciences at Carnegie Mellon's Mellon College of Science, has been developing the expansion microscopy technique to physically magnify a biopsy, allowing researchers to see fine details in biological samples using standard microscopes.

> *"This is the future of how scientists can handle complex data. It's an immersive experience, just like you are sitting inside your data."*
>
> *— Yongxin (Leon) Zhao,*
> *Assistant Professor of Biological Sciences*

Zhao makes biopsy samples grow in size by chemically transforming them into water-soluble hydrogels. This treatment loosens the tissues and allows them to expand more than 100 times in volume. The tissues and molecules within the sample can then be labeled, imaged and

compiled into a complex set of data to study interactions among cells and their structures.

However, a limitation of the technology is that it extracts two to three orders of magnitude more data than current techniques can interpret.

To remedy that problem, the grant pairs expansion microscopy with a VR technique developed at BRI at Virginia Mason, a healthcare system in Seattle, Washington.

Through VR technology developed specifically for the purpose, researchers will be able to see and manipulate the originally 2-D expansion microscopy images in 3-D — creating a 360-degree view of tissue and protein organizations and interactions.

The system to convert expansion microscopy data into VR 3-D images will be affordable and easily accessible to researchers and physicians in developing countries. It will also allow for up to six people to collaborate and view the same sample remotely at the same time.

"At BRI, we'll prepare the live infectious and autoimmune disease samples," said Caroline Stefani, senior postdoctoral research associate.

Biological Sciences graduate student Brendan Gallagher (S 2019) views expansion microscopy data using virtual reality.

"We'll send those to Carnegie Mellon, where they will enlarge the samples and send images back to BRI to be viewed in VR."

The VR technology was developed by Tom Skillman, BRI's former director of informatics and research technology, who has since founded a VR company, Immersive Science.

"Bringing all that data into VR not only allows the scientist to see their 2-D microscope images in full 3-D, but to interact with the data, selecting channels, adjusting the views, colors and contrast, and grabbing and rotating the images to quickly identify key aspects of the image that are coupled back to the disease under study," Skillman said.

The eventual goal is for the VR tool, called ExMicroVR™, to be shared on open platforms with other researchers along with expansion microscopy, so that they also can view new details of disease processes and understand larger, more complex sets of data.

"You have the freedom to explore your data from every angle and every spot."

— Yongxin (Leon) Zhao,
Assistant Professor of Biological Sciences

COMPUTERS CAN NOW BLUFF LIKE A POKER CHAMP. BETTER, ACTUALLY.

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THE WALL STREET JOURNAL.

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TUESDAY, JUNE 25, 2019

Argo AI to invest $15M in research lab at CMU

By Courtney Linder
Pittsburgh Post-Gazette

The buzzy self-driving car startup in which Ford invested $1 billion two years ago - Strip District-based Argo AI - announced Monday that it's making a financial promise of its own: committing $15 million to Carnegie Mellon University to establish an on-campus research hub.

Aptly named the "Carnegie Mellon University Argo AI Center for Autonomous Vehicle Research," the hub will be dedicated to at least five years of deep exploration into some of the greatest challenges for self-driving cars.

At the moment, this mostly includes advanced perception research, which helps vehicles "see" obstacles on the road, and vastly improved decision-making algorithms that help the cars' internal computers manage various courses of action they may take, opting for the safest one.

Deva Ramanan, an associate professor in the Robotics Institute who also serves as machine learning lead at Argo AI, will lead the new Argo lab.

Argo AI isn't the only company experimenting with autonomous vehicles on campus, though. Raj Rajkumar, a noted researcher in autonomous-vehicle technology - and the founder of a startup called Ottomatika, acquired by O'Hara-based self-driving firm Aptiv - runs the General Motors-Carnegie Mellon Connected and Autonomous Driving Collaborative Research Lab.

Uber is also funding on-campus projects.

Courtesy of Carnegie Mellon University

Argo AI has committed $15 million over five years to establish a research lab on CMU campus.

A young startup grows up

Argo AI CEO Bryan Salesky is a Pittsburgh native. From a young age, he recalls the city being the epicenter of self-driving research.

The university's first autonomous vehicle, he said, was called the Terregator. It was a mobile robot designed for both indoor and outdoor testing to study navigation, sensors and more.

"[It] drove at the lightning speed of several centimeters per second," Mr. Salesky said to laughs from the audience. "That was back in 1984. I was four years old."

A lot has changed since then.

Due in large part to early research like the Terregator, there is now a blossoming self-driving industry in Pittsburgh with companies such as Uber, Aptiv and Lawrenceville-based Aurora Innovation testing vehicles on our streets, in addition to Argo AI.

Since Argo was established in late 2016, it has grown from three employees to about 400. And, of course, there's that huge infusion of cash that Ford gave Argo mere months later in 2017.

Setting up shop on CMU's campus likely will create another huge benefit

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TUESDAY, JUNE 25, 2019

Continued from front

for the young company, considering that the demand for engineers in the self-driving space is fierce.

The lab creates a direct pipeline for fresh talent, allowing students to work in the lab while in school and possibly even secure a job at Argo AI upon graduation. Mr. Salesky calls these students the "next generation" of self-driving vehicle researchers.

Significantly, all research and software developed at the center will be open-source, meaning other companies or universities can leverage its findings.

Carnegie Mellon, for its part, will benefit from having new industry resources and research that it otherwise wouldn't have access to, such as private self-driving data sets, fleets of cars and other computer and hardware equipment that otherwise would be difficult to obtain, according to Mr. Ramanan.

'We can't do this alone'

Farnam Jahanian, president of CMU, said during a campus news conference that this partnership represents a new way of thinking about collaboration between industry and academia.

"We can't do this alone," he said before a room filled with industry experts, researchers, public officials and students.

Considering the formation of similar academic-corporate partnerships in the autonomous vehicles research space, that seems to be true.

At the Massachusetts Institute of Technology, there is a lab within its computer science and artificial-intelligence school completely dedicated to the development of self-driving tech.

Toyota put $25 million into this endeavor in 2015. The aim is to reduce traffic casualties and work toward creating a vehicle that won't get into accidents. Similar to CMU, the MIT lab is researching decision-making algorithms and perception systems.

At Stanford, Toyota spent another $25 million that same year to set up an autonomous research lab. Their focus is on "human-centered artificial intelligence for future intelligent robotics," as the university calls it. That basically comes down to developing new approaches to machine perception and reasoning, as at CMU.

At CMU, there also will be a human component to Argo's research.

Much to the delight of Pittsburgh Mayor Bill Peduto, who was in attendance, the center also will focus on safety improvements and explore ethical questions that arise from the commercial deployment of self-driving technology.

The mayor somewhat facetiously suggested that Argo and CMU employ some philosophers in the new lab.

In any case, he was hopeful that professors in the humanities will play a role in the research.

Meanwhile, Mr. Salesky said the partnership and financial arrangements for the new lab are about more than just advancing research: They also are about preserving the heart of self-driving car development in Pittsburgh, where he says it all began.

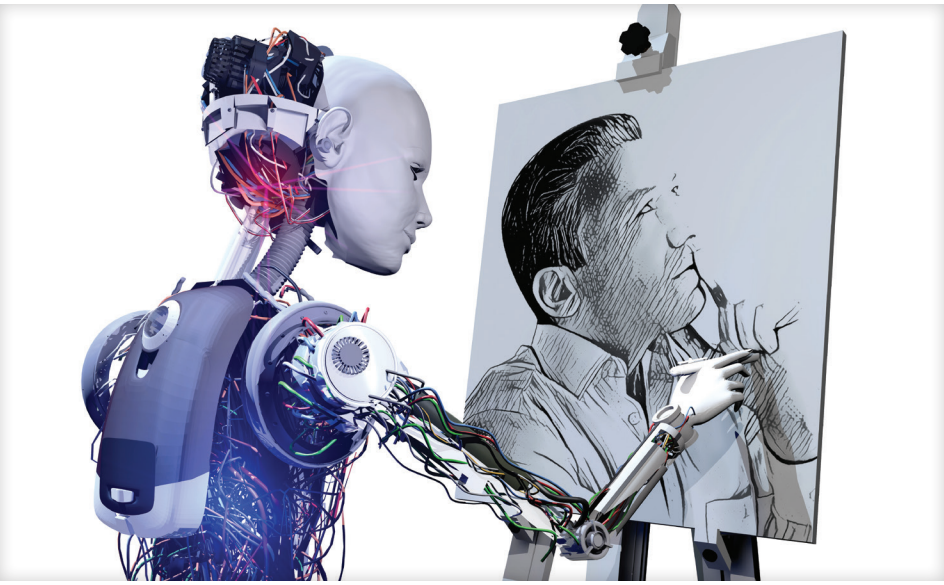
"This really is, truly, the birthplace of autonomous vehicles."

Courtney Linder: clinder@post-gazette.com or 412-263-1707. Twitter: @LinderPG.

ARTISTIC INTELLIGENCE:
CMU Leads a New Renaissance

APRIL 1, 2019

Artificial intelligence has entered the art space. AI has been used to create paintings, music, literature and poetry, to name a few disciplines. The use of algorithms in the creation of artwork raises tricky questions in the art world, possibly creating new gray areas in ownership and intellectual property.



Art and public policy are just some of the areas being explored by the CMU artificial intelligence research and education initiative, which brings together nearly 200 faculty members from throughout the university.

"The person who creates an algorithm owns the algorithm. If the algorithm is critical to the creation of the art — and the artist is a separate person — there's shared ownership that needs to be figured out," said Brett Ashley Crawford, associate professor of arts management at the Heinz College of Information Systems and Public Policy and director of the Arts Management & Technology Laboratory (AMT Lab) at Carnegie Mellon University.

Crawford said that in visual art, ownership is typically transferred upon sale, whereas in music and performing arts there's often a licensing agreement or a transfer of rights rather than ownership. If an algorithm is used to create music, and then that music is streamed on Spotify, the resulting payment structures may be quite complex. Similarly, if the images, music or data used to train an algorithm are not fully in the public domain or open source, that could complicate things even further.

"We're still in the first generation of artists working in these spaces," Crawford said. "In many cases, people are learning as they go to market. Sometimes they're learning the hard way because ownership hasn't been properly determined. There aren't best practices or public policies yet."

But as technology continues to progress, machines will play a greater collaborative role with artists, just as they will with so many other professionals. We can expect to see more and more art generated by AI as well as artists using AI as a tool. At CMU, AI influences artistic processes and arts management education.

"AI-powered art is permeating across the university," said Kathryn Heidemann (HNZ 2004), alumna of CMU's Master of Arts Management (MAM) program and former assistant dean of Heinz College and the College of Fine Arts. "CMU is expanding coursework in this space, with some exciting partnerships on the horizon."

Heidemann directed the MAM program from 2011-19 and is now chief academic officer and dean of faculty at the Cleveland Institute of Art. New York Live Arts is partnering with CMU and the MAM program on this year's Live Ideas festival, the theme of which is "AI: Are You Brave Enough for The Brave New World?"

There are a host of other initiatives at CMU, including gallery shows, symposia, art and machine learning classes, and multiple cross-disciplinary collaborations.

Carnegie Mellon students, faculty and alumni already have an impressive track record exploring the edges of arts, design and technology, establishing CMU as a leader in this space.

A TECHNOLOGICAL FUTURE FOR ARTISTS AND ARTS MANAGERS ALIKE

When we talk about robots replacing or disrupting the human workforce across industries, we usually temper it with the assurance that some skills are fundamentally human and not automatable. Economists suggest that future jobs will require more empathy and creativity from humans as these are not qualities easily replicated by machines.

Is that true for art and artists, though? Crawford said the truth is more complicated than that.

"Many artists are going to have to either work with coders or learn to code," she said, adding that art schools will need to follow suit by breaking down departmental silos and becoming more multidisciplinary.

CMU students are harnessing AI to create innovative art such as this Chinese landscape painting by Lingdong Huang (A 2019).

"For arts managers, these developments actually provide job security. The relationship between artwork and the audience can't be automated. Connecting the art to the audience still requires human beings, and that's what we do in the MAM program."

Heidemann said the broader arts community is starting to pay attention to how AI can be used as a tool for audience engagement, audience development and patron management.

"MAM students are taught to feel comfortable and confident with analytics and technology including AI tools. They don't have to be techies to use these things," Heidemann said. "Our curriculum addresses technological disruption across multidisciplinary arts. Rather than breaking out visual arts and performing arts as separate, we bring those sides together and look at how technology is changing things and creating opportunities across disciplines."

Crawford added that there is a general misconception among arts organizations that AI and technological tools are prohibitively expensive or require a staff of IT specialists to understand and implement.

"There are many AI opportunities that are low-hanging fruit for arts organizations. Our graduates can walk in and amaze people with what they can do," Crawford said.

Crawford said her students learn to use a new technology in every class, from project management tools and open-source GIS tools to creating a chatbot.

"You have to plan for the future. Is AI here to stay? Absolutely. Part of effective training for arts managers now is to understand where you have an appropriate use for AI or any technology," Crawford said.

"That's why technological knowledge is not siloed into a single class or set of classes here. It's spread across our entire curriculum."

CMU Alumnae Play Powerful ROLES ON BROADWAY

MAY 28, 2019

Broadway experienced an unexpected first last year: An all-female creative team assembled by alumna Leigh Silverman mounted a production of "The Lifespan of a Fact" by journalist John D'Agata.

"I feel it is our responsibility as we gain power and any kind of platform, that we continue to widen the road as we go," said Silverman, a 1996 College of Fine Arts graduate. "This is my fourth Broadway show, and I felt it was important to include, as I have throughout my career, women and people of color and put them in positions of power."

Earlier this year, three alumnae from Carnegie Mellon University — producer Jamie deRoy, costume designer Ann Roth and lighting designer Peggy Eisenhauer — received nine Tony Award nominations. Additionally, alumna Judith Light received the 2019 Isabelle Stevenson Award for her work as an advocate for LGBTQIA+ causes.

"My experience of being a woman working on Broadway has been nothing short of extraordinary, amazing in every way," Judith Light said. "These people and these casts and these productions — it's beyond words how much love and faith and support I've received."

Numerous CMU alumnae are making their marks on Broadway. Here are four who shared what inspires them, tools they still use from their CMU training and what advice they have for students following in their footsteps.

Kristolyn Lloyd (front row, left), Meg Zervoulis, Emily Skinner, Leigh Silverman (back row, left), Liz Coleman, Jamie deRoy and Peggy Eisenhauer are some of CMU's notable female alumni working in theater.

PAULA WAGNER

Paula Wagner (A 1969) experienced a sort of homecoming this year when she returned to her theater roots to produce the Broadway musical adaptation of the 1990 movie "Pretty Woman." Though she has been working in film since the late 1970s, Wagner's love for entertaining began at age 13 at the Youngstown Playhouse in Ohio.

Wagner cites her work in the theater for giving her the tools to move forward into a career as an agent and now a producer. Her agility and love of storytelling have given her career longevity and allowed her the ability to work across mediums.

"I think that the philosophy of Carnegie Mellon, 'My heart is in the work,' is a simple one, and it can be translated in many ways," explained Wagner, a member of CMU's Board of Trustees. "At CMU, there was a commitment to what we were doing, to the work we were doing, because it had a meaning and relevance."


Paula Wagner


Kristolyn Lloyd


Peggy Eisenhauer


Jamie deRoy

KRISTOLYN LLOYD

When Kristolyn Lloyd (A 2007) arrived at CMU to study musical theater, she was struck by the amount of talent that surrounded her. Those peers drove her to work hard.

"I think it's valuable for every young person to know that when they get into the business, there are going to be people that are better than you," Lloyd said. "There's something about adjusting to working in a competitive environment. You have to find a way to show up and do your work. That's what I learned at CMU."

Lloyd notes that being a black woman on Broadway has given her a unique voice and the ability to bring an important perspective to conversations about what a play is trying to say to its audience. Her noteworthy career has included roles on television and stage. She played Alana Beck in the original cast of "Dear Evan Hansen" and recently starred as Jo March in a new adaptation of "Little Women" at Primary Stages.

PEGGY EISENHAUER

Peggy Eisenhauer (A 1983) stands out as one of a few Broadway lighting designers who happen to be women. She refers to herself as a wild card — someone who has broken a barrier but hasn't left a path behind.

As a child, Eisenhauer saw Broadway productions and noticed the work of professional lighting designers. A favorite was Jules Fisher, and when it came time to apply to colleges, she chose his alma mater, Carnegie Mellon.

"I met him when I was 18, as a sophomore, because he came to school to give a talk. Flash forward to getting to work with him, not that much later when I was 23, it all sprung out of CMU," Eisenhauer said.

After graduating, Eisenhauer began assisting Fisher, and eventually formed a more than 34-year strong artistic collaboration. Together, they have earned three Tony Awards and have been nominated for a dozen.

"At CMU, there was a commitment to what we were doing, to the work we were doing, because it had a meaning and relevance."

— Paula Wagner

One of her best suggestions for young designers is to look for mentorship from many, not just from one person.

"You can find and cultivate a board of mentors who you can rely on that don't have to give their whole life to you but that can offer support."

JAMIE deROY

Jamie deRoy (A 1967) is a connector. As one of Broadway's most prolific producers, she helps get productions up, running and funded.

Her career in the theater began as an aspiring actress at CMU, where she learned the discipline and rigor that would lead her to a childhood dream, first formed when her father invested in the Broadway productions of "The Pajama Game" and "Damn Yankees."

After working as an actress on film, television and stage, she dipped her toe into the world of producing after seeing "The Complete Works of William Shakespeare (Abridged)." With more than 50 Broadway and 40 off-Broadway productions to her credit, deRoy has won seven Tony Awards.

"Everything is about connection for me. It snowballs — I didn't rush into things right at the beginning. I see something off-Broadway, like 'The Band's Visit' or 'Vanya and Sonia and Masha and Spike,' and become attached because I think it's a great production, or I like the director or writer."

See more profiles of CMU's Broadway alumnae at cmu.edu/ambassadors.

$10 MILLION GIFT
Endows Carnegie Mellon Deanship

JUNE 18, 2019

Carnegie Mellon University Trustee and alumnus Lane Bess and his wife, Letty, have made a $10 million gift to endow the dean's chair for the Dietrich College of Humanities and Social Sciences.

The gift allows Dean Richard Scheines and his successors to incentivize innovation around the college's strategic initiatives and emerging priorities across its nine departments and programs, and in its faculty and students. Carnegie Mellon will recognize this transformational commitment by establishing the Bess Family Dean's Chair of the Dietrich College of Humanities and Social Sciences.

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— President Farnam Jahanian

Lane and Letty Bess's $10 million gift allows Carnegie Mellon University's Dietrich College of Humanities and Social Sciences to incentivize innovation in its nine departments and programs.

Scheines, who was recently reappointed to a second five-year term, will be the first holder of the chair and will be installed in October.

"The essential work in the Dietrich College leads the way we study humanity, with the goal of creating real-world impact," President Farnam Jahanian said. "This extraordinary gift from Lane and Letty creates new opportunities for Dean Scheines to advance the interdisciplinary work that is a hallmark of the college's rich culture. The Bess's commitment to education and research will create unprecedented opportunities to advance human knowledge and improve the human condition."

Lane Bess, a 1983 Dietrich College graduate with a degree in managerial economics, is a global pioneer in technology and venture capital — launching startups and growing small- and medium-sized businesses to large-scale companies.

Bess is principal at Bess Ventures and Advisory, a strategic management, investment and marketing services firm focused on cultivating innovations in technology. He founded the firm in 2015, following a successful career as an

operating executive. Bess was the chief operating officer of Zscaler Inc., an innovator in cloud-based internet security services. Prior to that, he was CEO of Palo Alto Networks, where he led the company through early growth on the path to its IPO and to its position as a world leader in internet security.

"My years as a CMU student provided me with an exceptional education and the foundation that I needed to build a successful career and to become an entrepreneur," Bess said. "Letty and I are honored to be part of Dietrich College's future as its tremendous faculty guide the agenda for a modern liberal arts education and create exceptional scholars."

From creative writing and neuroscience to behavioral economics and bioethics, the Dietrich College is home to nine departments and programs as well as research centers that often cross disciplines, allowing the school's world-class faculty and students to investigate and solve real-world problems.

Among its faculty are nine fellows of the American Association for the Advancement of Science, nine members of the American Academy of Arts and Sciences, four members of the National Academy of Sciences, two members of the National Academy of Medicine and one member of the National Academy of Education. Its students hail from every corner of the world and train in a wide array of disciplinary approaches while focusing on research centered on humanity.

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Scheines, a professor of philosophy and champion for interdisciplinary research, was installed as dean of the Dietrich College in summer 2014 after spending nine years leading the Department of Philosophy. He first joined the faculty at CMU in 1990.

"We are so grateful to Lane and Letty, whose gift reinforces the importance of the college," Scheines said. "Dietrich embodies a collaborative, interdisciplinary environment for learning and research, and this gift is a transformative investment in our capacity to innovate. From now on, Dietrich deans will be able to seed exciting new research and bold educational innovations. I am truly honored to be the first Bess Family Dean of the Dietrich College."

In May, Bess was appointed to CMU's Board of Trustees. He also is a member of the CMU Swartz Center for Entrepreneurship Advisory Board and has shared his expertise as part of the Dietrich College Entrepreneurship Speaker Series.

The couple's previous support at CMU includes commitments to scholarships, internships and Dietrich College's groundbreaking Grand Challenge Seminars program.