Taking Care

College has long been a place for learning independence. But Rochester undergirds such lessons with a strong structure of support.

By Kathleen McGarvey

In his junior year, a frenetic schedule began to overtake Eric Cohen '13. He was trying to balance the demands of his major in engineering science with a consuming interest in drama that had him involved in the International Theatre Program, Drama House, student-run theater group The Opposite of People, and comedy improvisational troupe In Between the Lines. His health suffered from the erratic sleep schedule and eating patterns of on-campus life, due to his Type-1 diabetes. Taking insulin before a meal, as he must do, and adjusting the dosage based on what he'd be eating was difficult with dining hall buffets. And time was a problem, too. "It can be hard, finding the five minutes to take my insulin. Things just get so hectic—and grabbing some pizza doesn't work."

An overfull slate of extracurricular activities, academic pressures, difficulties sleeping properly and eating right—"it became too much," says Cohen, of Cleveland, Ohio. "I was

JOHN W. TOMAC FOR *ROCHESTER REVIEW*

The system focuses on helping students at the first sign of a personal or academic problem and on enlisting the entire campus community as a source of helping hands. Anyone can use the system to let Halligan know that a student may be in trouble by filling out a simple online form known as a Care report.

struggling to keep a grasp on all my responsibilities." He was hospitalized twice for chest pains related to a heart condition.

And then one day, he received an email from Erin Halligan, assistant director for student support services. Someone—more than a year later, Cohen still doesn't know who—alerted Halligan to the difficulties he was confronting.

"When I first heard from Erin, I was about to get kicked out—I wasn't doing well," Cohen says. "I'm pretty sure that in her message, Erin phrased it that 'I'm here to help.' And I was open to that."

Halligan, who holds a master's degree in mental health counseling and is completing a PhD in counseling education and supervision at the Warner School of Education, is the person at the core of a new—though long-evolving—student support system at Rochester dubbed the Care Network. The network has developed into a resource nationally recognized for its comprehensiveness, responsiveness, and accessibility. It serves undergraduate students and graduate students across the University.

The system is a manifestation of a new way of viewing and handling student life. For several generations at least, college has been a place for making the transition to adulthood in an environment that is, to some extent, protected. In the later 1960s, the idea of *in loco parentis*, the institution acting in place of the parent, fell on hard times, and students became increasingly responsible for making their own choices—and living with the consequences of poor ones.

But incidences of campus violence—perhaps most notoriously, mass shootings at Virginia Tech in 2007 and Northern Illinois University in 2008—along with heightened awareness of and response to sexual assault and other campus crimes have spurred colleges and universities across the country to assemble teams dedicated to addressing such problems.

Rochester's efforts at enhancing student support began more than a decade ago. Matthew Burns, dean of students, says: "Colleges and universities are under an incredible amount of pressure to care for their students in new and different ways. But we were caring for our students the way people were being encouraged to after Virginia Tech long before Virginia Tech."

The system focuses on helping students at the first sign of a personal or academic problem and on enlisting the entire campus community as a source of helping hands. Anyone—a faculty member who sees a reliable student suddenly failing exams, an undergraduate who sees a roommate reluctant to get out of bed, a facilities worker who finds persistent evidence of sickness—can use the system to let Halligan know that a student may be in trouble by filling out a simple online form known as a Care report.

"The reason the network is as successful as it is, is because it's supported all over campus," says Halligan. All reports are reviewed within 24 hours.

When the network was introduced two years ago, only faculty and staff could make reports, but last year it also became available to students and families—in fact, to anyone, on campus or off, who sees reason to be concerned about a student's well-being. Several students have even reported themselves in an effort to find help efficiently. In 2011–12, the network received 525 reports, a marked increase over the 427 submitted the previous year. In 2012–13, after the system became accessible to all for reporting, Halligan received 927 reports, a 117 percent increase from the number just two years before—a rise she chalks up to greater accessibility and visibility for the system. Because of that growth, Halligan will soon be joined by a full-time coordinator who will aid her in assessing reports and reaching out to students.

Reports can be triggered by something as slight as a normally diligent student suddenly missing several class meetings, but the network also encompasses actions as serious as suicide threats. Because it can take relatively little to move the system to action, Burns calls the network "as close to proactive as it can be."

It's the "fruit of a long effort, and the end result is so thoughtful," says David Bevevino, senior analyst at the Education Advisory Board, a Washington, D.C., based group that provides best-practice research and advice to higher education leaders. The board highlighted the network for its methods of identifying students of concern, its transparency, and its marketing efforts to promote its use in a 2012 study of how colleges and universities respond to students in need of help.

"It's a resource. It's not disciplinary," Cohen says. He established a routine of weekly meetings with Halligan, who helped him to manage his time better and take better care of his health. He became such a believer in the program's value that he has worked to spread the word, urging other students to take advantage of it. He led a discussion of the network after the performance of a play about gun violence in the spring semester in response to last December's elementary school shootings in Newtown, Conn.

"I'm definitely an advocate, 100 percent," he says.

The network evolved from a more typical form of student intervention: a weekly campus-conduct meeting that involved officials representing residential life, security, the office of the associate dean of students, and the University Counseling Center. The group evaluated security reports and decided how to handle issues of misconduct. But those involved realized that their efforts could be more effective if they could intervene with students before they reached the point of misconduct.

In the fall of 2002, Burns created the Student Support Network, a roundtable that brought together staff from all corners of campus—including the College Center for Advising Services, the Office of Minority Student Affairs, chaplains, the bursar's office, and financial aid—to help students while their problems were more manageable. But the group's large size was both a strength and a weakness, raising issues of confidentiality.

To address that dilemma, Burns streamlined the process, using the software package Advocate by Symplicity to track students headed for trouble, with the concerns initially fielded by a single source—Halligan, who began her position in fall 2011.

Richard Feldman, dean of the College, says: "We thought the thing to do was set a quite low threshold, that if you just were

Care App

This September a new Care Resource Center app debuts. It will help students connect with resources according to their concern, finding students' locations using GPS in their phones and giving them directions to the office that can best provide help. "It's a way to connect students to resources from their dorm room," says Erin Halligan, assistant director for student support services, who oversaw the app's development. Liz Rothenberg—a practice manager at the Education Advisory Board, a Washington, D.C., based group that analyzes best practices in academic affairs, student affairs, and other areas of higher education—calls the app "something that truly stands out. It's really meeting students where they are."

JOHN W. TOMAC FOR *ROCHESTER REVIEW*

concerned about somebody, you could identify that person and there could be follow up. And it might turn out that there's not much of a problem; it might turn out that there is."

Melissa Kelley, a health educator in University Health Service and a frequent participant in the network, likens Halligan to a detective, receiving clues to students' situations and investigating to find out what kind of help, if any, they might need.

"I proceed on a case-by-case basis," says Halligan. "I talk with the student, assess what their needs are, and get them to where they need to be." Some students need a counselor, whether academic or personal. Others, a psychotherapist. Some could use a mentor—and others just need an adult to talk with once in a while. "Almost everybody at the University has served in that capacity at one time or another, if they have something to do with students. Students who can't find that person can find them through the Care Network, we hope," says Burns.

The issues reported were predominantly academic ones when Halligan began the job—but once the system became open to all, she started to see more reports of emotional and mental health problems. And "problems that ostensibly come from the academic realm may actually have their origins in emotional issues," she says.

Because anyone can file a report, the network gives "an ability to get a 360-degree picture of a student's life," says Eleanor Oi, academic advisor and director of orientation. That makes it easier for the University to intervene appropriately in cases where it might not otherwise recognize the need. And intervening when a

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> “There’s a balance to be struck, and it’s not crystal clear where the line is,” Burns says. “This is not a support system that should prevent failure altogether. If a healthy student makes the decision that they want to fail out of school, at some level do you have to say, you’re allowed to fail out if you want? You’re allowed to make bad decisions if you want.”

problem is just beginning gives a student more options. Once a real crisis hits, the choices become more limited— typically, hospitalization, medical leave, or withdrawal, says Bevevino. Early intervention also saves students and the University time and effort. “We are trying to find students who are headed for trouble at the earliest possible moment so that the amount of resources it takes for both them and us to get them back on track is minimal,” says Burns.

At the same time, he and others are mindful that the network shouldn’t create an environment that is overly watchful, coddling students rather than supporting them. “There’s a balance to be struck, and it’s not crystal clear where the line is,” Burns says. “This is not a support system that should prevent failure altogether. If a healthy student makes the decision that they want to fail out of school, at some level do you have to say, you’re allowed to fail out if you want? You’re allowed to make bad decisions if you want. There are consequences, but we’re not going to prevent you from making the kinds of decisions that you have a right to make.”

The Education Advisory Board carried out research on current practices for what it calls behavioral intervention teams at more than 200 schools in the United States and Canada last year. Rochester’s system is a “mature effort” compared to what the researchers found at other schools, where intervention programs are mostly at earlier stages of development, says Liz Rothenberg, a practice manager at the board. In the wake of the Virginia Tech shootings, many schools established crisis teams, but didn’t advertise them broadly for fear of adding to anxiety, Rothenberg says, noting that Rochester has taken the opposite tack, making its services highly visible and widely accessible.

Even the name “Care Network” reveals a different emphasis, she says. “In a lot of places, it’s called something like ‘Threat Assessment’ or ‘At-Risk Students.’ What Rochester has created is much friendlier. It’s easier to submit a ‘care report’ than an ‘incident report.’ ”

Kevin Allan ’14, a neuroscience major from Sharon, Mass., has seen the network from both sides, as someone who has submitted reports and as someone who’s had a report submitted on his behalf.

In 2012–13, Allan was a resident advisor in the Susan B. Anthony residence hall, where he oversaw 32 freshmen. As part of his training, he was taught how to use the network, and he referred students to it who were feeling homesick or experiencing other difficulties, such as having to miss exams because of a death in the family.

Like Cohen, he felt pressures mounting as the fall went on, from his responsibilities as an advisor, his own heavy course load, and his work as a teaching assistant in two classes. Someone, he doesn’t know whom, saw his stress level rising and submitted a report about him. Initially, he was taken aback. “When you first see the email, you feel a little stigma: ‘Someone thinks I’m not OK,’” he says. But meeting with Halligan “made life feel manageable,” and he says he’s now thankful that someone alerted her to his anxiety. “It shows someone cares about you, and took the time to write.”

Oi says the cumulative effect of so many people being able to submit a report is a kind of safety net that could never exist otherwise. “If I meet with a student and I gather information, I may see one chunk of their life, where someone else sees another chunk, and someone else, another. If someone’s really in crisis, it can be that all of those little chunks moving together” reveal the scope of the problem.

And for people, such as faculty members, who may become aware of a student’s problems without having the expertise to guide the student, the network is an appreciated resource.

“The idea here was explicitly not to ask faculty members to solve the problem with the student, not to intervene in ways they might not be comfortable doing, but just to have a place to let someone know,” says Feldman. “The network makes it really easy. I think that’s important. It’s extending the network of people who might be able to get something like this started to faculty, and now to students and families and others.”

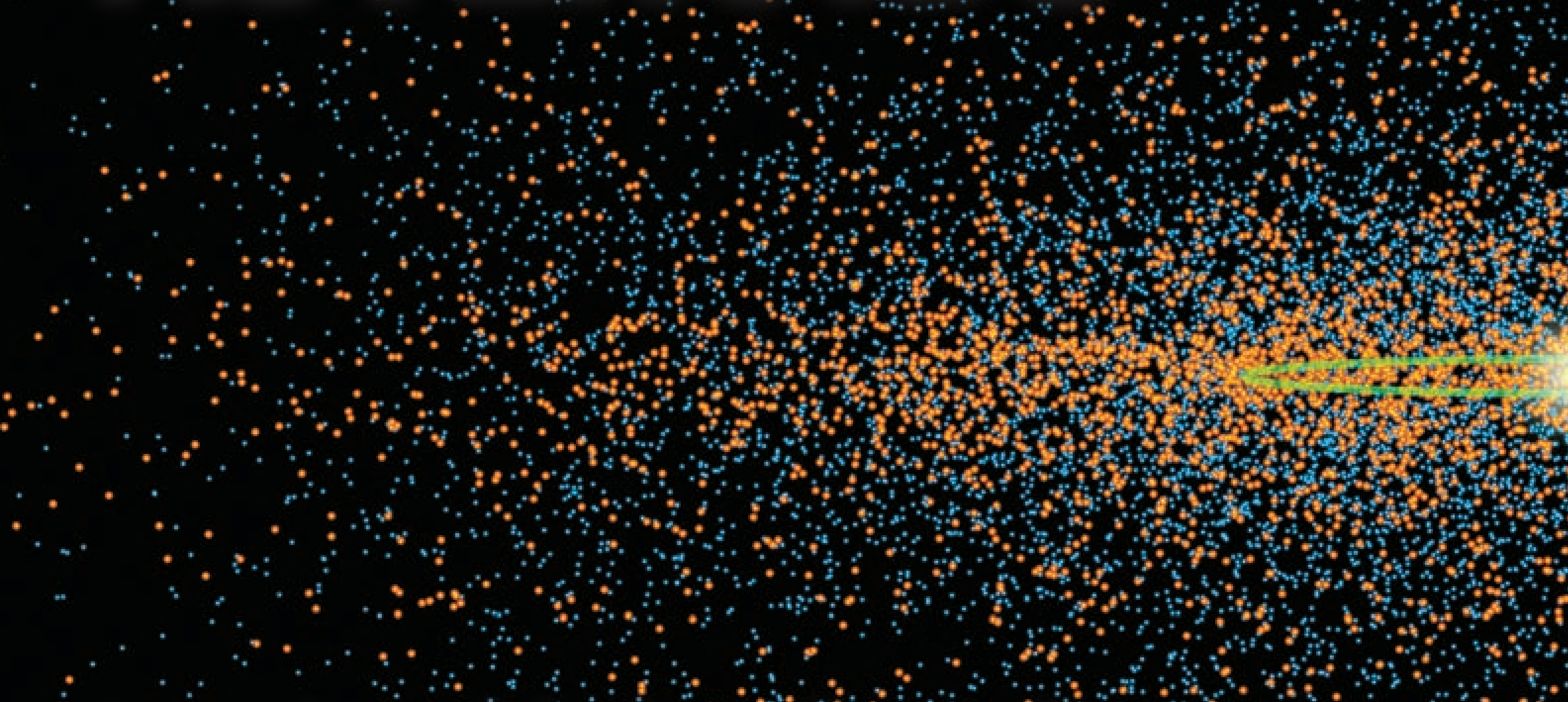
Heather Layton, a senior lecturer in art and art history, has filed reports for about half a dozen students. “It was a relief to get advice from colleagues on campus who had access to a broader range of information about the student. While the privacy of the student was entirely protected and the details of any situation were kept confidential, it helped tremendously to have validation of a situation and to understand whether or not I’m taking the right approach in teaching or advising,” she says. It alleviates her own anxiety “to know that there is a network of support on campus rather than it just resting on one person’s shoulders.”

The percentage of people seen at the University Counseling Center because of a report is small, says Brigid Cahill, associate director of the center. “Because people don’t know who we’re seeing, people sometimes file a report for someone who’s already in treatment here. People seem to get here on their own—but for people who don’t, and for whom there’s enough concern, I think that’s the valuable piece of Care: for students who are falling through the cracks, Care helps to catch them.”

When Bevevino looks at the network, he sees something distinctive. “It’s part of what you do as a student, or a faculty or staff member, at Rochester—you make a report and get students the support they need.” R

For more about the Care Network, visit www.rochester.edu/care.

Accounting for ASTEROIDS



A proposed space mission aims to add up asteroids with the potential to cause catastrophe on Earth.

By Scott Hauser

In the ongoing background noise of potential natural disasters vying for your attention—hurricanes, tornadoes, earthquakes, lightning strikes—the idea that a random piece of rock from outer space will cross paths with our lonely blue planet is most likely a distant worry.

And if a project involving a team of Rochester scientists and researchers at NASA's Jet Propulsion Laboratory in California succeeds, you may eventually be able to rest even easier when it comes to the faint possibility that an asteroid will strike Earth with catastrophic consequences.

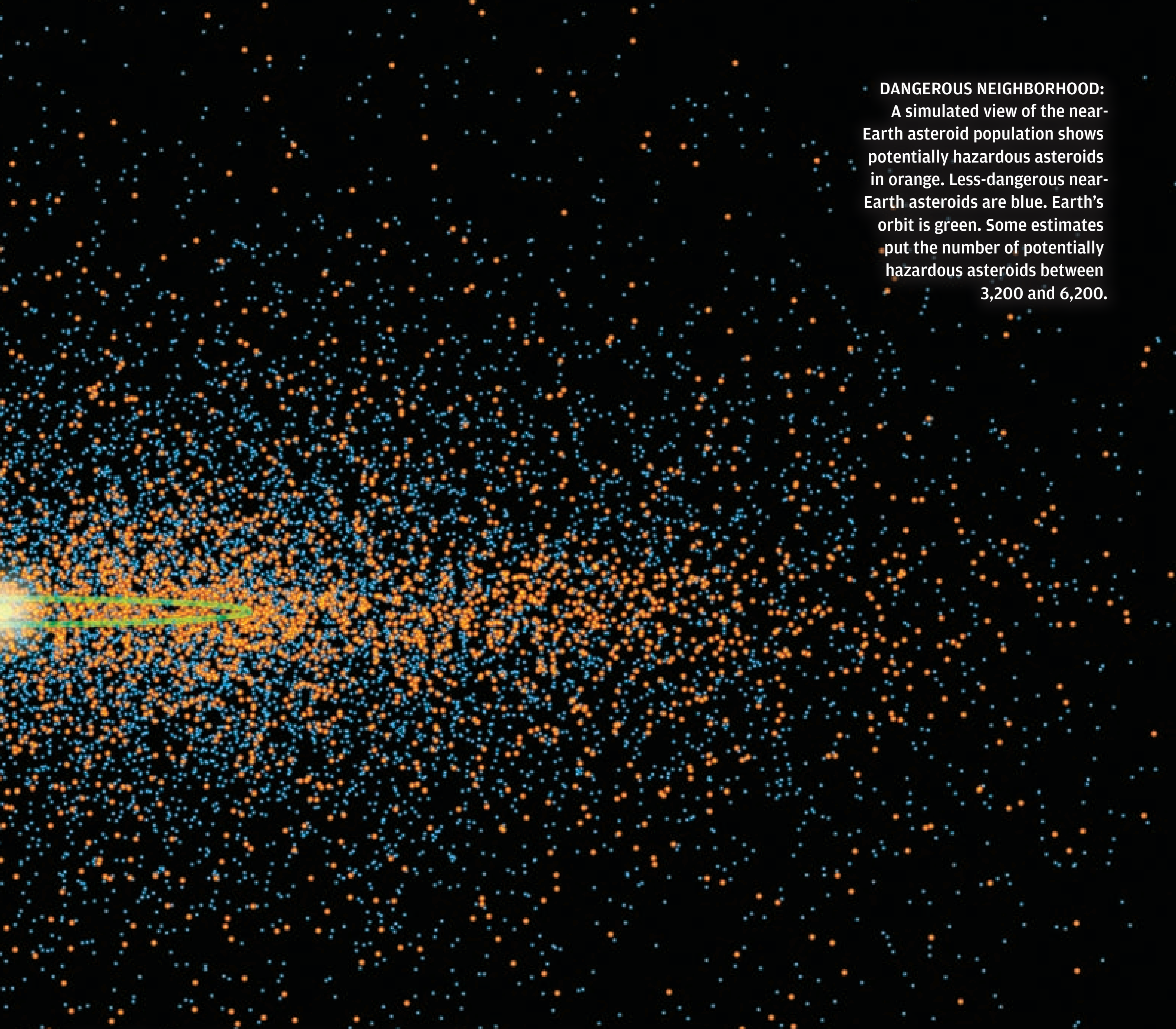
Or at least put the possibility into the same category as earthquakes and hurricanes—a potential hazard, to be sure, but one that can be predicted and prepared for, if not averted.

"How do you respond to something that's low in probability but potentially high in consequence?" asks Amy Mainzer, the principal investigator for two JPL missions designed to survey space for asteroids and comets. "You don't ignore it, but you don't panic either. You try to take the reasonable, measured response to the situation. In the case of the earthquakes, we certainly study earthquakes; we employ sensor networks to try to detect them.

"In the case of the asteroids, the first thing you want to do is go find the asteroids and see if there are any that are on a potentially hazardous course."

For much of the past decade, Mainzer and colleagues at Rochester have been collaborating in an effort to improve the ability of space telescopes to map the course of asteroids. The long-term goal is to put in place a network of detection—involving both space-based and ground-based observatories—that will alert observers when asteroids or comets are on a collision course with Earth, allowing disaster professionals the time to prepare a course of action to avert as much of the danger as possible.

This spring, the team of Craig McMurtry, a senior engineer, Judith Pipher, professor emerita, and Bill Forrest, professor emeritus, all in the Department of Physics and Astronomy, along with Mainzer, reported an important breakthrough in that effort. The Rochester team, which has been one of the leading centers of research on



DANGEROUS NEIGHBORHOOD: A simulated view of the near-Earth asteroid population shows potentially hazardous asteroids in orange. Less-dangerous near-Earth asteroids are blue. Earth's orbit is green. Some estimates put the number of potentially hazardous asteroids between 3,200 and 6,200.

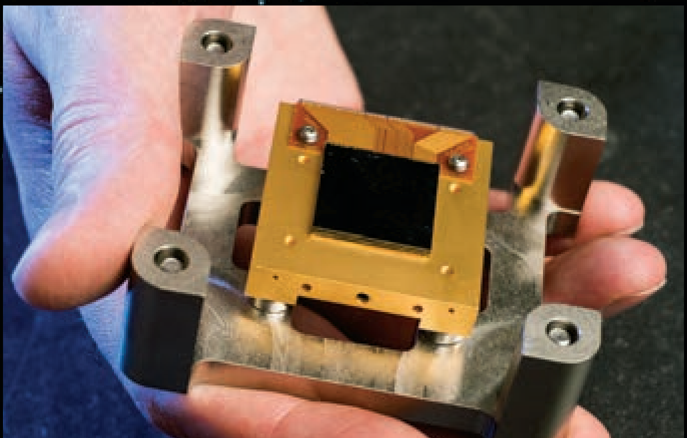
infrared detectors for space missions since the early 1980s, reported that a new generation of sensors appears ready to serve as the electronic eyes of a mission designed to hunt for "near-Earth objects."

With initial funding from NASA, the group is proposing a new space-based telescope that would sit close to Earth's orbit and use infrared sensors to scan the sky for asteroids whose orbits have taken the interstellar rocks out of the main belt between Mars and Jupiter and put them on a possible collision course with Earth.

Named NEOCam, or "Near-Earth Object Camera," the mission would be able to detect objects that have a diameter of about 30 to 50 meters—about the size of an office building.

While that won't account for all the objects that have the potential to cause catastrophic damage, it would go a long way toward filling in a wide swath of missing information about asteroids, their orbits, and the materials that they are made of.

When such near-Earth objects are relatively small—objects the size of basketballs are estimated to enter the atmosphere once or twice a week—they dissipate harmlessly in the atmosphere.

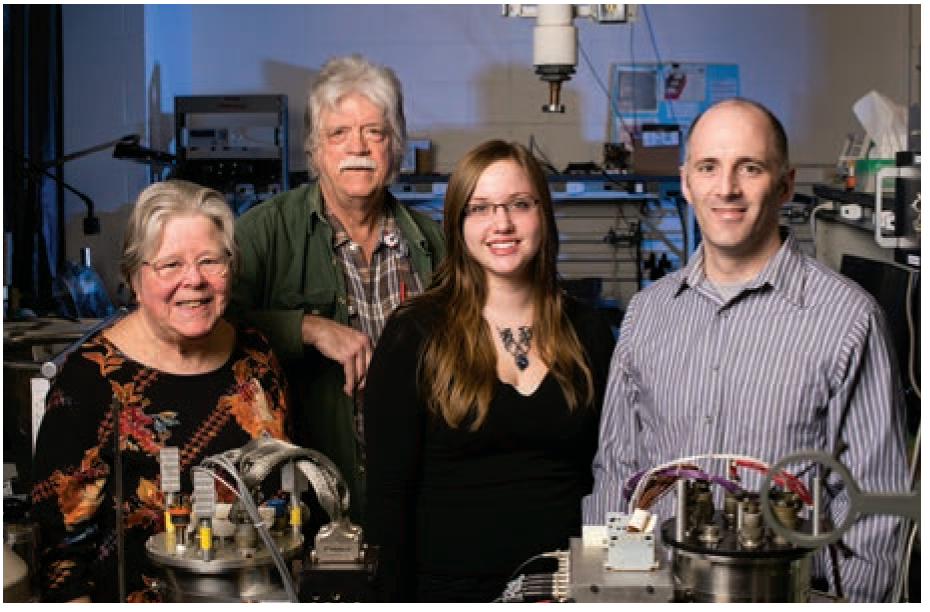


SPACE BOUND? A proposed space mission to look for asteroids near Earth would include a new version of an infrared detector developed and tested by Rochester researchers.

NASA (ASTEROIDS); ADAM FENSTER (SENSOR)

The larger they get, of course, the greater their potential for destruction. The world was reminded of that last winter when an asteroid estimated to be 17 to 20 meters in diameter entered the atmosphere over the Ural region of Russia and exploded about 30 miles from the city of Chelyabinsk. And in 1908, an asteroid or comet estimated to be at least 50 meters in diameter flattened more than 800 square miles of Siberian forest near Tugunska, Russia. And 65 million years ago, a collision with a near-Earth object believed to be about 5 to 10 kilometers in diameter resulted in the extinction of the dinosaurs.

In 2011, Mainzer published the most detailed census yet of large and midsize asteroids, reporting that the majority of the objects with the most lethal potential—those larger than 1 kilometer in diameter—have been found and that many of the ones measuring between 300 meters and 1 kilometer had been spotted. Part of a project she led called the NEOWise survey, the results were based on data from the Wide-field Infrared Survey Explorer, or WISE, a NASA mission launched in 2009 that was designed to scan for luminous galaxies and stars with a cooler temperature signature.



ROCHESTER TEAM: The new array is the latest in a 20-year research effort led by Judith Pipher (left), Bill Forrest, and Craig McMurtry (right). They were joined by graduate student Meghan Dorn (third from left).

Like the WISE mission, NEOCam is based on the asteroid-hunting technology of using infrared radiation as a way to spot dark, nonreflective objects. Although invisible to humans, infrared radiation can be used to measure the heat being emitted by an object, making it ideal for searching for objects like asteroids. Asteroids don't emit their own light, but when warmed by the sun, emit enough infrared radiation to stand out against the ambient radiation of space.

But unlike WISE, the proposed NEOCam mission will be designed to scan specifically for asteroids and other near-Earth objects, and where the longest wavelength detections in WISE were based in silicon, the new sensors would be made of a newly developed combination of mercury, cadmium, and tellurium. The combination allows the sensors—akin to a megapixel camera chip—to collect infrared wavelengths up to about 10 microns, the range at which most asteroids emit infrared radiation.

In a paper published in the *Journal of Optical Engineering,* the Rochester team reported that the new sensors could operate comfortably at about 40 degrees above absolute zero, the temperature at which most space-based telescopes eventually live out their lives in space. The ability to operate at 40 degrees Kelvin means the NEOCam craft would not have to carry an artificial coolant such as liquid helium or solid hydrogen, a requirement for silicon-based arrays, which operate best at 10 degrees or less above absolute zero.

"It doesn't sound like a big difference—they both sound really cold—but to an instrument astronomer working on space telescopes, it's night and day," says Mainzer. "With these new detectors we can get away with not using cryogen to keep them cold. The benefit is that they can enable the mission to have a very long life. And if you're patrolling for asteroids, you want to be built to last."

Pipher and Forrest started working on sensors with the new combination of materials nearly 20 years ago, when they saw the sensors' potential for operating at higher temperatures.

"Our partners at Rochester have pioneered using and developing these kinds of long-wavelength detectors," says Mainzer. "There is really no other group that has the experience with this type of array. The Rochester group is the only group that's ever tested the long-wavelength version of the device, that I'm aware of, for astronomy purposes."

The new work is part of long history for the Rochester team, which also developed a sensor to measure infrared radiation of a different wavelength that's currently aboard NASA's Spitzer Space Telescope, which was launched in 2003 and continues to operate, even though its cooling system has run out.

The Rochester team worked with the space instruments company Teledyne Imaging Sensors to develop and test the new sensors. If all goes as planned, the new detectors will be capable of capturing 16 megapixels of light and will be paired with a complement of sensors at a shorter wavelength to allow for more precise measurement of asteroids.

While the mission has more NASA approvals to get through before a launch date can be set, the team envisions that, over time and with further development, the ability to make such measurements eventually could add up to a more advanced system for keeping track of asteroids that's analogous to the National Oceanic and Atmospheric Administration's efforts to track hurricanes and other storms. As science gets better at detecting asteroids and tracking their orbits, a warning system could be put in place that gives people more options for dealing with potential impacts. For larger impacts, trying to divert the objects might be possible. For smaller objects, a future system could provide enough warning for people to get out of harm's way.

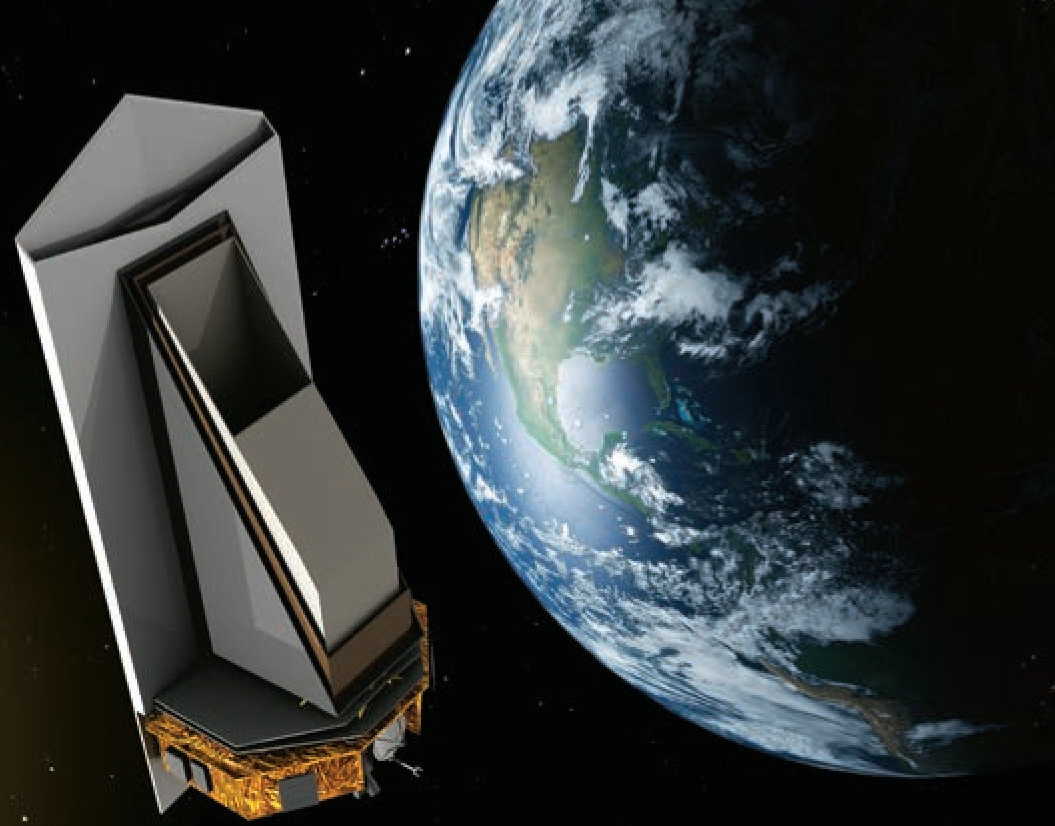
"That's what science has done," Pipher says. "We've invested in the NOAA to make this prediction and to track hurricanes, and they're very good at it."

Says McMurtry: "The same thing will be true one of these days for asteroids." ®

ADAM FENSTER (TEAM); STEVE BOERNER (GRAPHIC)/SOURCE: NASA AND JET PROPULSION LABORATORY)

Stationed in Space

The NEOCam telescope—shown here in an artist's rendering—would be stationed at a position where it could efficiently observe the comings and goings of asteroids and other near-Earth objects. The spacecraft's orbit, about 1.5 million kilometers from Earth, is far enough away that the telescope can be in a stable, cold environment, but close enough that it can maintain high-speed data transmission with scientific teams. The space-based position also gives the satellite a view that's unimpeded by cloud cover, sunlight, and other impediments faced by ground-based observatories.



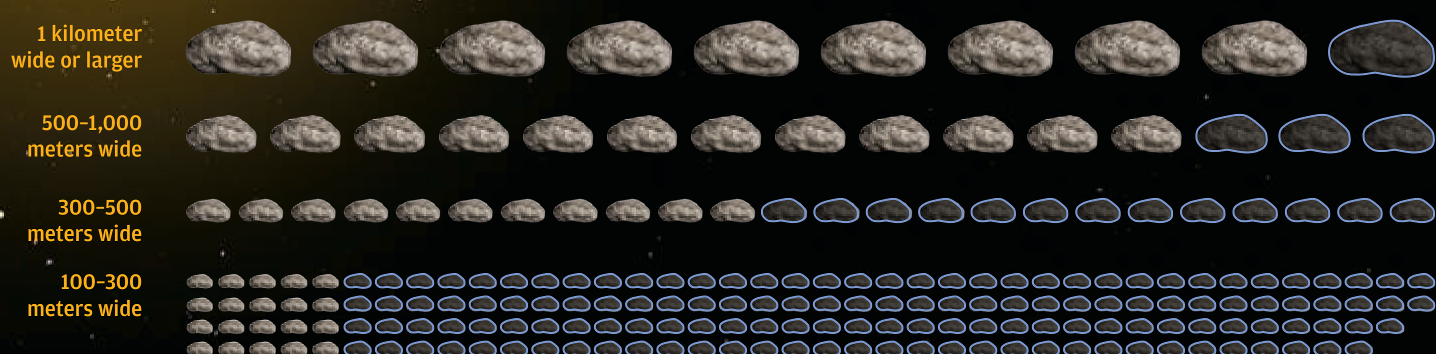
How Many Asteroids?

More asteroids of all sizes are discovered each year, and recent observations have helped astronomers fine-tune their estimates of the number remaining to be found.

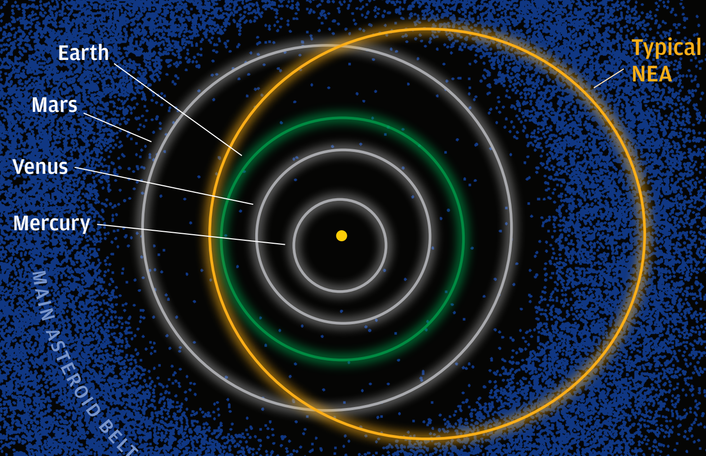
Each image represents 100 objects.

Known asteroids

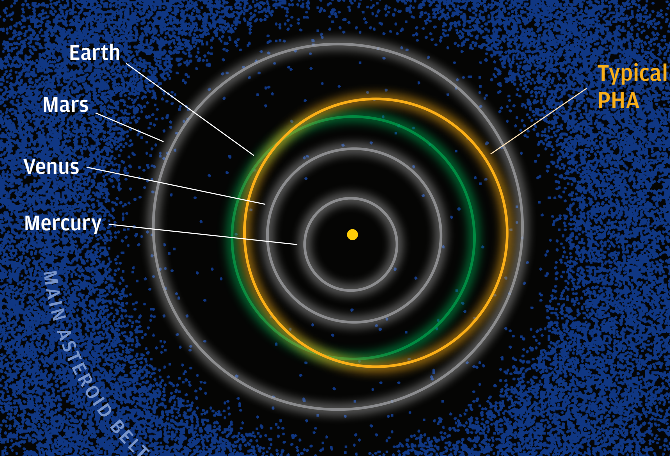
Estimated total



Near-Earth Asteroids have orbits that wander from the main asteroid belt, outside the orbit of Mars, to within 28 million miles of the Earth's orbit, shown here in green.



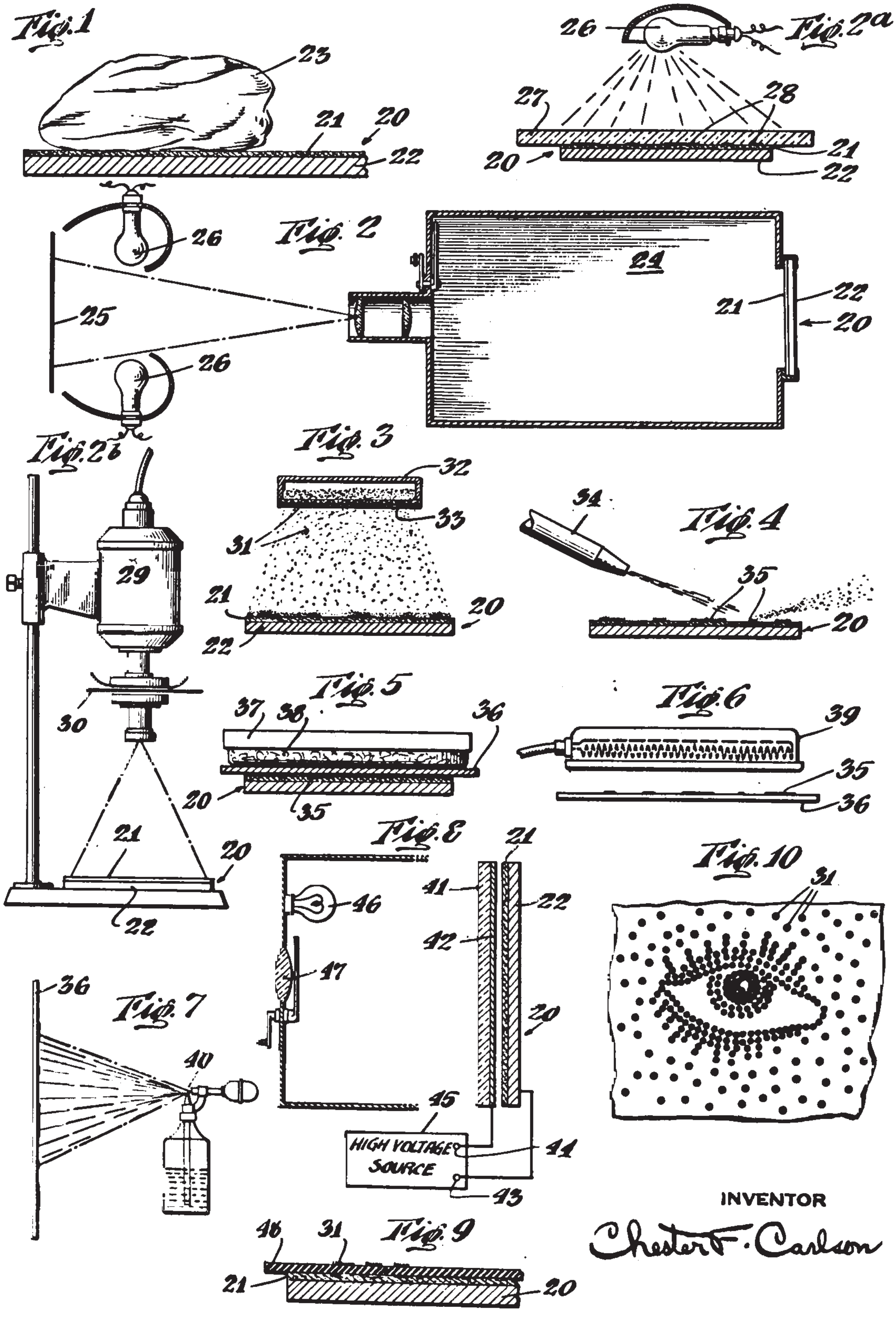
Potentially Hazardous Asteroids are the NEAs that graze the orbit of Earth, coming within 4.6 million miles, and are large enough to cause widespread damage.



Oct. 6, 1942. C. F. CARLSON 2,297,691

ELECTROPHOTOGRAPHY

Filed April 4, 1939



COURTESY OF XEROX CORP.

DUPLICATION: In 1962, Carlson reenacted his historic 1938 experiment (above), a process he outlined in his 1939 patent application (opposite).

ELECTROPHOTOGRAPHY, XEROGRAPHY, AND US

ELECTROPHOTOGRAPHY, XEROGRAPHY, AND US

When a persistent inventor and a thoughtful executive joined forces, they transformed American business and helped build the modern University of Rochester.

BY KAREN MCCALLY '02 (PHD)

COURTESY OF XEROX CORP.

IT WAS A CRAMPED, SECOND-STORY ROOM AT 32–05 37TH STREET in Astoria, Queens, in which Chester Carlson set his sights on testing the process he called electrophotography. A converted kitchen, it contained a sink with running water, a gas connection, and enough space for the tinkerer and his hired assistant to maneuver amidst their setup of jars, plates, and a small flood lamp.

Carlson was a serial inventor. He was a trained physicist about to earn a second degree, in the law. He'd kept notebooks since high school, chock full of drawings and notations recording his ideas for an array of devices. A rotating billboard. A machine to clean shoes. A raincoat with gutters.

Otto Kornei was an unemployed physicist who found a part-time job assisting Carlson his lone prospect in Depression-era New York.

What they accomplished on the morning of Oct. 22, 1938, would prove historic.

Carlson was ingenious conceptually, but Kornei was the first of many scientists who would play an important role in executing Carlson's ideas through careful fine-tuning of materials and methods. Kornei pulled the shades closed, and in the darkened room, coated a zinc plate with sulfur. He rubbed the plate with a cotton handkerchief, giving the plate an electric charge. He took a glass slide on which he'd written "10–22–38 ASTORIA" in India ink, pressed it against the charged plate, and placed both the slide and plate under a lamp. After 10 seconds, he removed the plate and dusted it with a fine powder. When he blew on the powder, the image 10–22–38 ASTORIA shone on the plate.

It was the first known electrostatic image, a major technological milestone. It now sits in the Smithsonian, but might well have been discarded unceremoniously had it not been for Carlson's persistence and the prescience of Joseph Wilson '31, a young executive of a struggling business who saw the potential of electrophotography that so many others missed.

This October marks the 75th anniversary of Carlson's Astoria experiment. On the River Campus, students and staff in the Chester F. Carlson Library of Science and Engineering have long observed the October anniversary, but this year's celebration will feature a new exhibit that Melissa Mead, the John M. and Barbara Keil University Archivist and Rochester Collections Librarian, has titled "True Original: Chester Carlson's Xerography at 75."

The exhibit will place Carlson's invention in historical context and showcase the complementary relationship between Carlson and Wilson in exploiting its possibilities.

"I hope that exhibit viewers will have a better understanding of the duplication processes available prior to the 914, and the transformative vision of both Carlson and Wilson that led to xerography as a process and as a business," says Mead, alluding to the Xerox 914 photocopier that transformed the American office when it was introduced in 1959.

The University is a fitting place for such a display, and not merely because it will grace the library dedicated to Carlson in 1972 by then President W. Allen Wallis. It will draw from the University's substantial collections of artifacts, papers, and photographs of both Carlson and Wilson. And it will suggest the interdependence of research universities and the communities in which they operate.

Both Carlson and Wilson established charitable foundations that continue to contribute handsomely to the Rochester regional economy. Wilson in particular grasped the importance to business of having access to a first-tier research university, and in his roles as benefactor and as chairman of the board of trustees, presided over a transformation of the University in the 1960s from a respected regional institution to a top research university with a national reputation. Wilson, it's fair to say, left as indelible a mark on the University as George Eastman.

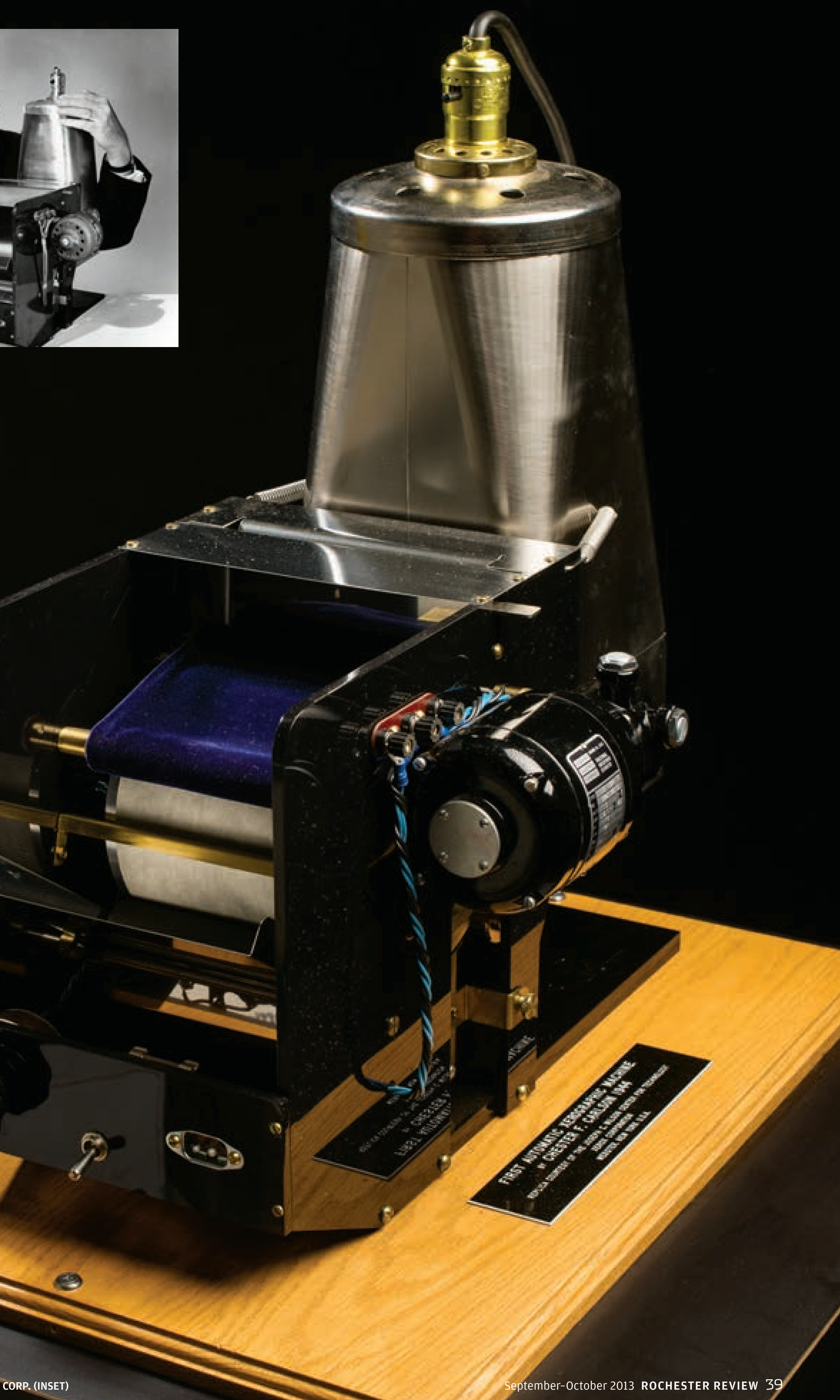
The fortuitous encounter between Carlson and Wilson has made for a classic story in the annals of American business history. Carlson grew up in poverty, worked his way through Caltech, toiled for years on his ideas, only to have his breakthrough invention dismissed by virtually every company he approached.

Wilson was the one businessman who was intrigued—so intrigued that he staked the future of his small photographic paper manufacturer, Haloid, on Carlson's invention. The investment created a corporation that revolutionized the white collar workplace, and whose new name, Xerox, became synonymous with photocopying itself.

When Wilson met Carlson in October 1946, "their meeting would mark the turning point for both," wrote Wilson biographer

ORIGINALS: Jars of substances (left) that Carlson used to produce the first electrostatic image (above), are showcased in the University's Carlson Library.

ADAM FENSTER (CHEMICALS); COURTESY OF XEROX CORP. (INSET)



REPLICATION: Carlson (above) demonstrates the first xerographic machine. A replica of the 1944 machine is on display in the Carlson Library.

ADAM FENSTER (MACHINE); COURTESY OF XEROX CORP. (INSET)

Charles Ellis, a prolific author and businessman. In some respects, they could not have been more different. Carlson had moved three times by the time he was six, lost his mother when he was an adolescent, and worked to support himself and his father, who suffered from debilitating spinal arthritis. Having finished his schooling during the Great Depression, he hopped from job to job to piece together satisfactory and remunerative work.

Wilson was born in Rochester to a family whose roots extended to the city's earliest settlements. His father, Joseph R. Wilson, Class of 1903, was an accomplished small businessman and civic leader, and when Wilson graduated from Rochester in the midst of the Depression, there was a job waiting for him at Haloid, the company cofounded by his grandfather.

But Carlson and Wilson shared a couple of key tendencies. They were, by many accounts, deep and thorough readers, and persistent and creative thinkers. In their respective fields of science and business, both Carlson and Wilson were keenly aware of the paths that were well tread, and the importance of avoiding them in favor of new ones.

ROLLOUT: Haloid's John Dessauer, Carlson, and Wilson test an experimental xerography machine at the Battelle Institute in 1948.

Carlson, who would eventually have numerous patents to his name, took an early interest in patents, finding employment in the patent office of the electrical components manufacturer P. R. Mallory. Patents required many copies to be made, but making carbon copies proved difficult, as did another available method, using a photostat machine. Carlson envisioned an "office copier," yet he knew not to go down the obvious route, which was conventional photography.

"I recognized quite early that if conventional photography would have worked for an office copier that it would have been done before by the big companies in the photographic field who certainly would have explored that possibility pretty thoroughly," Carlson said in a 1965 interview. "So I deliberately turned away from the conventional photographic processes and started searching in the library for information about all the different ways in which light will affect matter."

The principle Carlson would explore was photoconductivity, and it was well understood by the time he set out to explain in his 1939 patent application how it might be brought to bear upon electrophotography.

Photoconductive materials become better conductors of electricity when exposed to light. Carlson explained that if a thin layer of photoconductive material were to be applied to certain types of metal surfaces—zinc or aluminum, for example—the surface could be exposed to light to create an electrostatic image.

In the case of the Astoria experiment, sulfur was the photoconductive surface. Rubbed with a handkerchief in the dark, it obtained an electric charge. When Kornei pressed the glass slide against the charged surface, he ensured that whatever effect exposure to light would have on the charged surface would be transferred to the slide.

But the India ink he'd applied to the slide created a region that would literally be blacked out from the effect of the light. When the slide and the charged plate were illuminated, the sulfur surface retained its electric charge in areas blocked out by the ink. The rest of the plate constituted, Carlson explained, the "white part," in which the electrical charge would essentially "drain off." When Kornei applied a fine black powder to the plate, static electricity ensured that the powder would remain affixed in a layout identical to his original ink scrawl.

Carlson allowed great flexibility in materials and even in the process itself. He outlined procedures for copying from three distinct types of surfaces—glass, paper, and film. "While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention," Carlson wrote.

As it turned out, that flexibility—which could too easily be interpreted as the lack of a fully fleshed-out idea—may have been the seed of his problems. He began writing to companies in the office equipment industry seeking their interest in developing the patent. He wrote to more than 20—IBM, RCA, General Electric, Remington Rand—all major players in the industry. He received, at best, perfunctory interest, with minimal follow up, and no firm commitments.

Carlson had found himself in a Catch-22. Prospective investors wanted to see more than the crude demonstration he'd performed with Kornei's help. They needed to see a machine. But without investors, Carlson couldn't easily produce a machine. He tried hiring small manufacturers to produce a machine cheaply, but those earliest manifestations were marred by mechanical and design problems—evidence, it seemed, that electrophotography wasn't as promising as the persistent inventor insisted.

Timing also played a critical role in Carlson's fortunes. It was World War II. Large companies were focused on war-related production and were confident that they'd continue to prosper after postwar reconversion to civilian industry.

Wilson, however, was just as confident that without a new business model, his small company would fail.

Carlson would later recall that Wilson was "a very brilliant young man," who had struck him immediately as "an aggressive, young, imaginative person." Wilson, then 36, had recently succeeded his father, Joseph R. Wilson, as president of Haloid, a company that had started in 1906 as a maker of photographic paper.

Wilson saw that the postwar period looked ominous. His hometown competitor, Eastman Kodak, was supplying its own paper, squeezing Haloid into a niche market of specialized paper for portrait photographers. To make matters worse, Haloid was

COURTESY OF XEROX CORP.

purchasing raw materials for its paper from Kodak.

Haloid had been dogged by Kodak's success even before the war. In 1935, it had purchased the Rectigraph Company, for whom it had been a key supplier. Rectigraph was the maker of the eponymous machine that's considered among the first photocopying machines. But it was not an office copier in any real sense. It was a photostat machine, copying documents through a photographic process that relied on a camera and a chemically based development process. It was large, slow, messy, and expensive. Moreover, it was too large and expensive for most businesses to own themselves, limiting its market to shops that would offer the machine's services as a primary line of business. While the purchase kept Haloid afloat through the Depression, Wilson knew that Kodak would quickly surpass any advantage of Haloid's in photographic copying.

"There are those in financial circles who say that chance and luck brought the Xerox Corporation into existence," the chemical engineer and Xerox executive John Dessauer wrote in his 1971 memoir, *My Years with Xerox*. "I prefer to think that it was a matter of diligence."

DESSAUER WAS AMONG THE SCIENTISTS AT HALOID WHO scoured technical journals in search of ideas for new applications that could lead to new products that could save the company. The first turning point for both Wilson and Carlson came in 1944. The nonprofit Battelle Memorial Institute committed to investing $10,000 in Carlson's patent, with an entitlement to 60 percent of any future royalties. Scientists at Haloid tipped Wilson off to the technology and to Battelle's interest.

Wilson was captivated. After some further research, he traveled to Battelle's Columbus, Ohio, laboratory to see a demonstration of electrophotography for himself.

Committing Haloid to invest in the technology would be a huge risk. Nevertheless, at Wilson's urging, Haloid, renamed Haloid-Xerox in 1958, and Xerox in 1961, would invest virtually all of its resources in the development of the technology it later coined "xerography."

In hindsight, Wilson's dogged pursuit of xerography seems easy to explain. The purchase of Rectigraph had signaled Haloid's commitment to the nascent document copying business. Electrophotography was a potential means for document copying that wasn't based on chemistry, which was Kodak's strength. It was based instead on physics. For Wilson, electrophotography offered the promise that Haloid could compete in the copy business without competing directly with Kodak. What's more remarkable is that Wilson was able to carry this commitment through more than a decade of failed attempts and modest progress before the release of the blockbuster Xerox 914 photocopier in 1959.

Taking that risk made Wilson a modern business hero. "Wilson was, in retrospect, astonishingly able to develop and hold steadfastly onto an inspiring yet abstract vision and to advance repetitively toward fulfilling and realizing that vision in specific, pragmatic ways," Ellis wrote.

Carlson, whom Wilson retained as a consultant in the development of xerography, summed up his legacy succinctly. Modest by all accounts, he insisted he didn't invent anything truly new. "I certainly added no new scientific knowledge as did the transistor inventors, for example," he said. But what he did acknowledge doing, is at the heart of much innovation: "I merely combined a set of facts in a new way." Ⓡ

The Road to the 914

It took more than a decade for Haloid, renamed Xerox in 1961, to harness Carlson's electrophotography to create the first successful photocopying machine, the Xerox 914.

1949 The XeroX Model A marked Haloid's first attempt to produce a xerographic photocopying machine. Requiring more than a dozen manual steps to operate, it was poorly received.

1956 The Copyflo, which was fully automated, was a major improvement over the Model A. However, at the size of a small truck, it was also prohibitively expensive for the mass business market.

1959 The Xerox 914, named for its ability to photocopy on 9" x 14" paper, was not without flaws. But a relatively small size, reasonable cost, and skillful marketing made it a hit. It graced the cover of *Time* magazine in September 1959.

NATIONAL INSTITUTE OF HEALTH (TOP); COURTESY OF XEROX CORP. (OTHERS)

Sculpted Spaces

The Memorial Art Gallery embarks on its next 100 years of cultural leadership with the opening of Centennial Sculpture Park.

FUN FAMILY: Memorial Art Gallery patron Joan Feinbloom sits with artist Wendell Castle among the pieces of *Unicorn Family,* Castle's sculpture for Centennial Sculpture Park, during a celebration marking the park's formal dedication.

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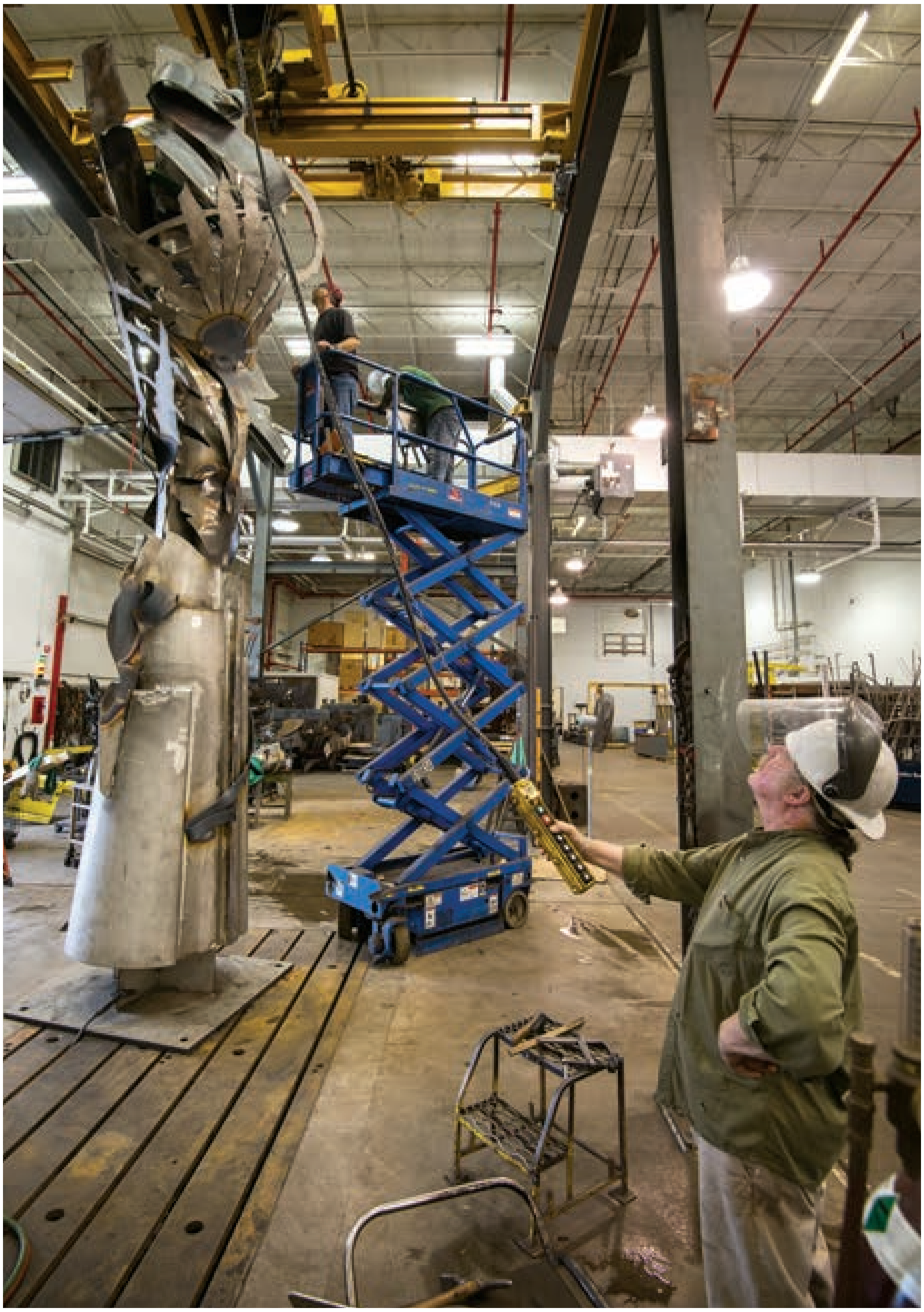


SCULPTURAL STORIES: Sculptor Albert Paley (foreground) guides some of the finishing touches on *Soliloquy,* his commissioned piece for Centennial Sculpture Park. The 25-foot polychrome stainless steel sculpture will be installed late this summer.

ADAM FENSTER

New park is designed to extend the gallery's connections to the community.

When the doors to the Memorial Art Gallery opened 100 years ago this fall, the museum's chief benefactor, Emily Sibley Averell Watson, had one important stipulation: that the doors be open to all citizens of the community. Watson's belief that a world-class museum enriches the cultural and civic life of the community is taking new shape this year with the opening of Centennial Sculpture Park, a 10-acre showcase of public art and landscaped urban space designed to celebrate the gallery's cultural leadership as well as to build stronger ties to the gallery's surrounding neighborhoods.

Nancy Jurs
Emergence (1995)

Deborah Butterfield
Wailana (1999)

George Rickey
Two Lines Up Excentric—Twelve Feet (2000)

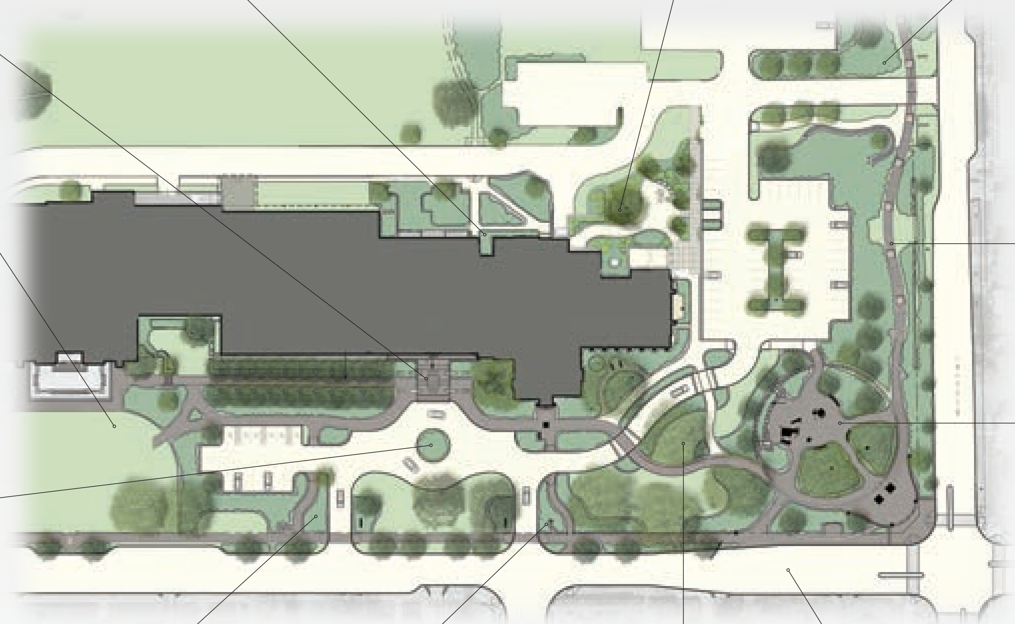
Albert Paley
Millennium Bench (2000)

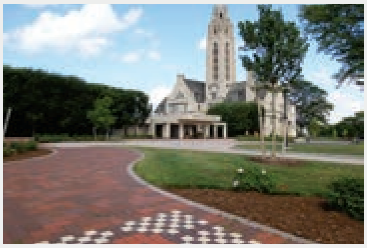
MEMORIAL ART GALLERY

Todd McGrain
Passenger Pigeon (2007)

Mary Taylor
Filly (2008)

Albert Paley
Soliloquy (2013)





Jackie Ferrara
Marking Crossways (2013)

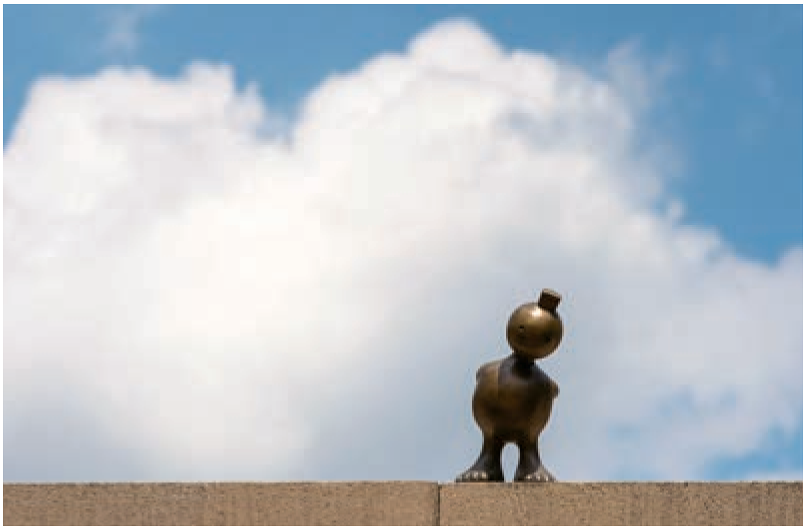
Tom Otterness
Creation Myth (2012)

Wendell Castle
Unicorn Family (2013)

Beverly Pepper
Vertical Ventaglio (1967–68)

Tony Smith
Playground (1962–66)

EPIC TALE: ***Creation Myth,*** **a site-specific commission by sculptor Tom Otterness, tells the story of an artist—depicted by figurines that dot the park (right)—who is trying to bring a larger work of art to life (above).**



With installations by four internationally recognized sculptors anchoring the grounds around the gallery, the new park features sculptures from the gallery's collections, interactive walkways, whimsical gathering places, and venues for public performances—all integrated with other arts and cultural initiatives such as ART-Walk, an effort to transform the Neighborhood of the Arts into an outdoor museum. Ⓡ

The gallery will celebrate its 100th anniversary with a public birthday party on the grounds of the museum on Sunday, Oct. 13.

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WALK THIS WAY: Featuring walkways commissioned from artist Jackie Ferrara—including *Path of Colors,* a red and orange brick pathway that connects Goodman Street and University Avenue with the gallery's main entrance (above)—the park is designed to encourage visitors to linger (left).

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