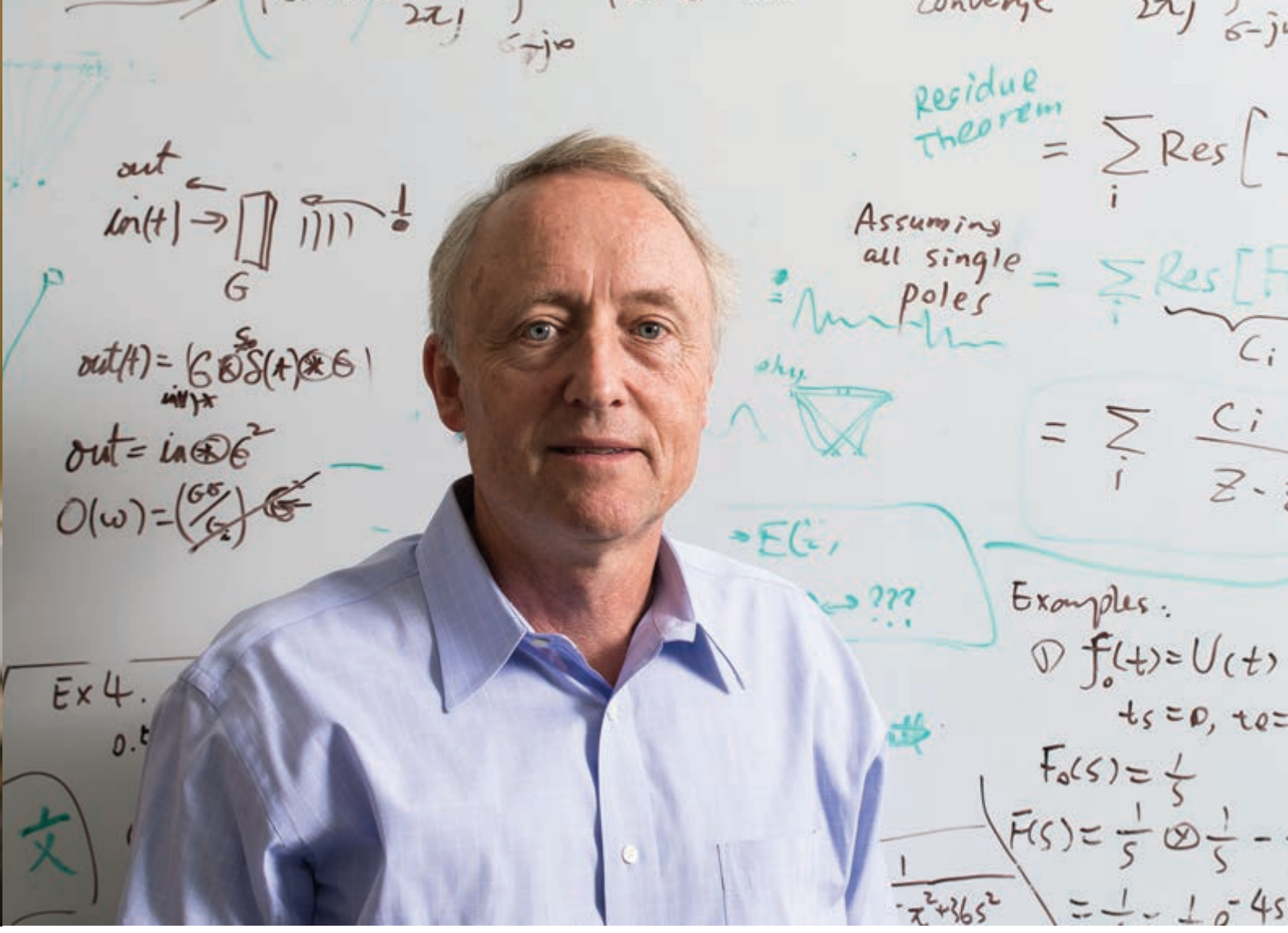
Image Ir

Two University engineers helped transform the early days of the digital revolution, setting off a "virtuous cycle" of research and invention that continues to be felt decades later. That's the largely untold story of the blue noise mask.

MASK TEAM: Focusing her dissertation on research that would dramatically improve the way computers produced images, Mitsa (above) worked with Parker, a member of the electrical and computer engineering faculty (opposite) who early on saw the potential of the discovery.

BIZUAYEHU TESFAYE/AP IMAGES FOR *ROCHESTER REVIEW*



nventors

By Alvin Powell

Theophano Mitsa ’91 (PhD) walked into her advisor’s office one morning in the early 1990s. Mitsa was there to talk about finishing her doctoral dissertation, a highly technical project on something called a “blue noise mask,” whose aim was to improve images in printers, fax machines, and computer screens.

“He said, ‘You know what, Theo? You have to start thinking about philanthropy,’” Mitsa recalls. “I said to myself, ‘What is [he] talking about? I’m hardly scraping by. *I* need philanthropy.’ ”

Sitting across from Mitsa that day was Kevin Parker, a junior professor of electrical and computer engineering at Rochester who had long been intrigued by the intersection of computer technology, medical research, and imaging.

“I guess he had an inkling this was going to be big from the beginning,” Mitsa says. “I never thought that I had anything big. Never in my wildest dreams.”

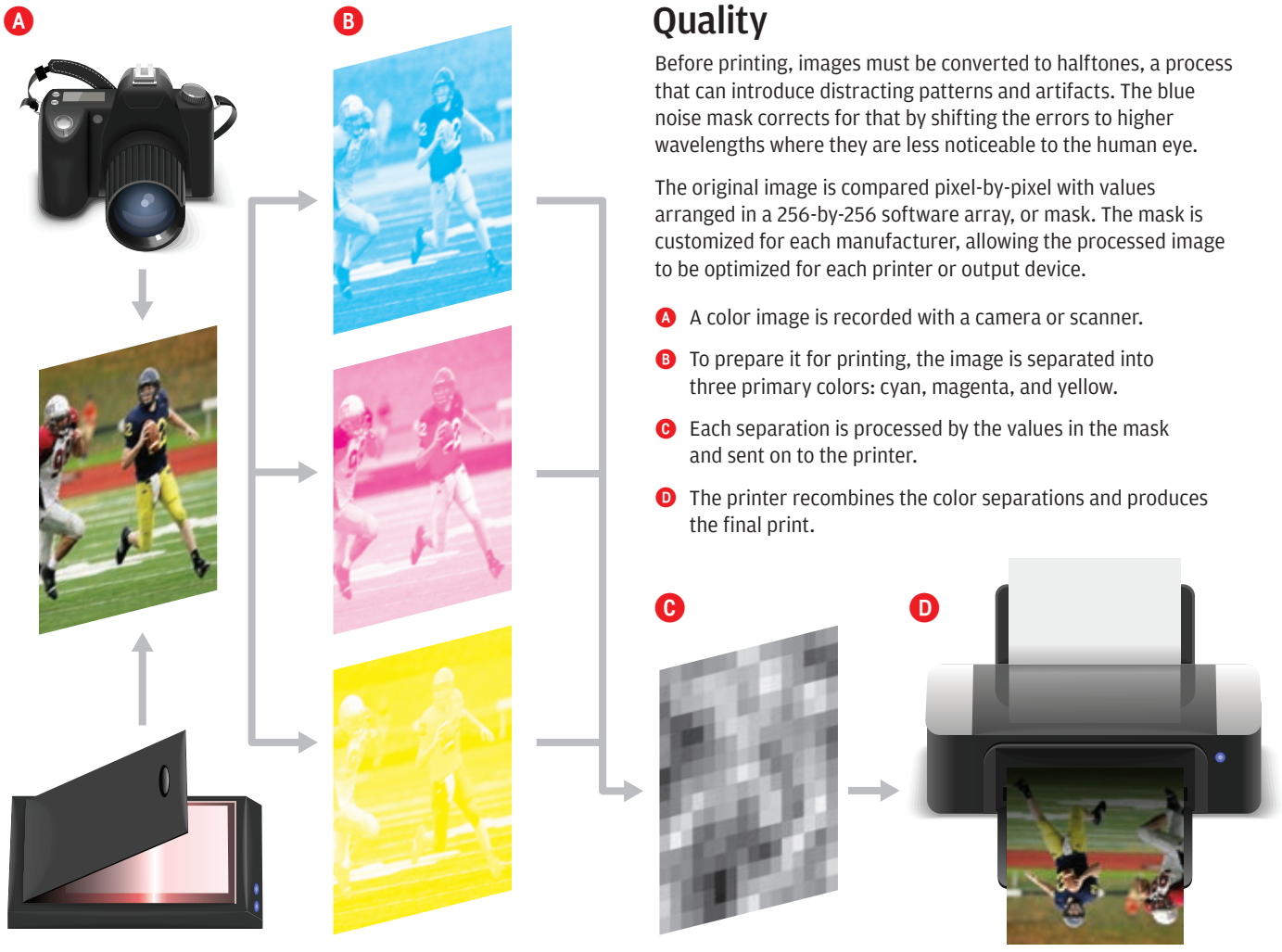
Judging from that day’s evidence, Parker, who would go on to become dean of the engineering school for several years, was also adept at fortune telling.

In the midst of Mitsa’s reams of equations and lines of computer code, Parker saw what would turn out to be one of the most lucrative

ADAM FENSTER

Printing by the Numbers

In the early days of the digital revolution, image rendering was time consuming and often produced poor-quality results. Blue noise mask technology, patented in the early 1990s by the University, revolutionized the process by dramatically improving rendering quality and speed.



Quality

Before printing, images must be converted to halftones, a process that can introduce distracting patterns and artifacts. The blue noise mask corrects for that by shifting the errors to higher wavelengths where they are less noticeable to the human eye.

The original image is compared pixel-by-pixel with values arranged in a 256-by-256 software array, or mask. The mask is customized for each manufacturer, allowing the processed image to be optimized for each printer or output device.

- **A** A color image is recorded with a camera or scanner.
- **B** To prepare it for printing, the image is separated into three primary colors: cyan, magenta, and yellow.
- **C** Each separation is processed by the values in the mask and sent on to the printer.
- **D** The printer recombines the color separations and produces the final print.

Speed

Once it's created and installed, the same mask can be used to process every image produced by a printer, fax, or other device. That eliminates the need to do time-consuming calculations on the fly for each image and results in significant time savings when compared to other halftoning methods.

Advanced Error Diffusion, 3 minutes

Bayer's Dither, 4 seconds

Blue Noise Mask, 4 seconds

patents in the University's history. The blue noise mask—a deceptively elegant technological process that transformed how electronic devices in the early days of the digital revolution rendered images—turned out to be the kind of paradigm-changing discovery that academics live for.

Since that day in the early 1990s, the invention of the blue noise mask has generated some $30 million in royalties for the University, one of the most lucrative in Rochester's history. It's surpassed only by a Medical Center team's work that led to vaccines against human papillomavirus (HPV), now marketed as Gardasil by pharmaceutical giant Merck and as Cervarix by GlaxoSmithKline, and by work by Porter Anderson, professor emeritus of pediatrics, in the lab of David Smith '58, former chair of the Department of Pediatrics, that led to a vaccine against pneumococcal meningitis, sold as Prevnar by Wyeth (Pfizer).

And while the blue noise mask was invisible to consumers and became a standard part of printer drivers and other software, the story of the invention played out as an often grueling, up-close education in patent law involving some of the biggest players in the computer industry of the 1990s and 2000s.

But as the patents for the technology expire within the next year and as the power of personal computer technology has advanced beyond the often bandwidth-deprived days of the 1990s, the story has shifted to one of legacy for the University and its inventors.

The dollars have allowed the institution to invest in new faculty, programs, and buildings, kick-starting what Parker describes as a "virtuous cycle" in which invention begets funding which—once reinvested in teaching and research—begets more invention. That, in turn, brings in more royalties, to the benefit of the institution, its faculty, and students.

"If you can generate good tech transfer outcomes, that generates new things back at the university," Parker says. "That allows the teaching and research mission to get bigger and better, and generates another round of things. That's the ultimate goal."

Rob Clark, the dean of the Hajim School of Engineering & Applied Sciences and senior vice president for research, says that, in addition to the financial benefits that have followed from the invention, the blue noise mask illustrates that inventions—even ones narrowly focused to solve a specific problem—can have broad impact. Its success, he says, sends an encouraging message to faculty about the benefit of working to translate basic discoveries beyond the lab.

A Quirk in Human Vision

In many ways, the blue noise mask was the perfect invention at the perfect time. By the early 1990s, desktop computers had a firm hold in homes and offices. The dot matrix printers that accompanied them in earlier years could only print in black and white.

But those printers were giving way to ink-jet and laser printers, able to render shades of gray in black-and-white images. They could also create a wide range of colors from just three basic colors using a process called halftoning.

Those early devices, however, were slow, consumed gobs of computing power, and turned out images that awed no one. Among the unimpressed was Parker, a medical imaging expert. For him, the print quality problems went beyond mere aesthetics. Parker saw CT scans and ultrasound images so poor that there was the chance something important could be missed.

"The medical images that we'd put out were awful, really awful, because of halftoning," Parker says. "So I was very interested in that aspect of it. Everyone had an ink-jet or laser printer by then and yet the renditions were terrible."

Mitsa arrived on Rochester's campus as a Fulbright fellow from Greece in fall 1986. Interested in imaging, she nonetheless agreed to do her early graduate work with Edward Titlebaum, a professor of electrical and computer engineering who was working on computer coding related to the Star Wars defense program, Mitsa says.

After receiving her master's degree a year later, Mitsa looked at her situation from a practical standpoint. If she received her doctorate based on defense work, her most likely employer would be the U.S. government or a defense contractor. As a foreign citizen, she realized, she was unlikely to get hired for such sensitive work.

So Mitsa talked with Parker, an affable, thoughtful professor and a careful researcher, who was full of ideas. One colleague described him as "the kind of guy you hope to find at a university."

Parker was interested in the problems of quality and speed plaguing halftone images, and set Mitsa to the task of improving them.

"All of the halftone techniques of the time left a pattern, what we would call an artifact, a mistake, a characteristic flaw," Parker says. "You're adding a weird pattern onto what should be a natural medical image, whether a CT scan or an ultrasound. If the artifact goes right through a small tumor, you may never see that it's a small tumor."

> "Generating a good blue noise mask is a really, really tough problem that requires lots of computer time. Once you make a good blue noise mask, once you crack that nut, you have it. It's a set of numbers for the computer . . . it can paint-by-numbers your image really quickly and better than other halftone techniques."—*Kevin Parker*

The process of halftoning creates images by using a limited palette to create an array of tiny dots whose composition and density render different shades and colors. In black-and-white images, for example, the printer prints only black dots, but creates shades of gray by altering the location and density of the dots. Fewer dots and more white space results in lighter shades, allowing the creation of complex images.

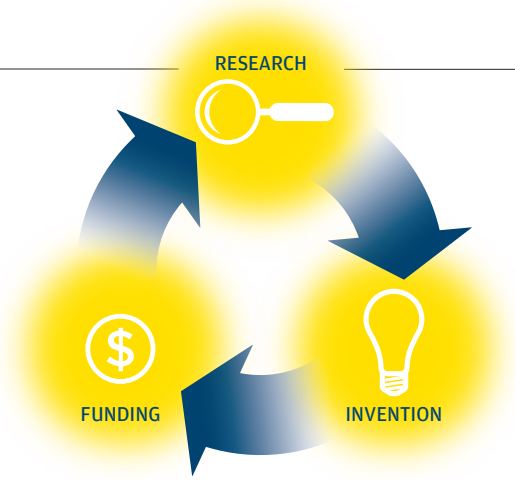
Similarly, color images can be made using a halftone process that changes the dot composition and density of just three basic colors: cyan, yellow, and magenta.

Parker learned that the quality problems might be solved by adding "blue noise" to the image, a technique that would shift otherwise distracting errors in the printing process to higher wavelengths where, because of a quirk of the human eye, they would be less visible.

But the existing blue noise algorithms were slow and cumbersome to use for the computers of that time, and were not free of unwanted patterns. Parker suspected that a fixed array of numbers could be constructed in advance that would contain all the required blue noise patterns.

The result, in theory at least, would be images that were more pleasing, more accurate and, potentially, could be rendered more quickly in a "paint-by-numbers" scheme that any computer could rapidly use.

"Blue noise is high-frequency noise," Mitsa says. "You want blue noise in halftoning because it takes all the noise in the halftoning process and moves it to the high frequencies where your eye cannot see it. So your eye gets the big picture, the shapes . . . it's not disturbed by the distribution of dots in high frequencies."



A 'Virtuous Cycle'

One of the University's most lucrative patents, the invention of the blue noise mask has left a lasting legacy at the Hajim School of Engineering & Applied Sciences.

In what inventor Kevin Parker calls a "virtuous cycle," the royalties have established funds to support faculty positions as well as research projects in biomedical engineering and in electrical and computer engineering. The goal is that with such support, faculty and students will be able to conduct research, develop innovative ideas, and commercialize discoveries and technology. Ideally, that process of invention, research, and funding becomes a continual cycle.

Endowed Professorships

Funded with royalties from the blue noise mask, three endowed professorships have been established in the Department of Electrical and Computer Engineering and two endowed professorships have been established in the Department of Biomedical Engineering.

Faculty Development

Licensing revenue has supported funds for faculty research, graduate students, and for innovation and education. The royalties have also supported the addition of three faculty positions in the Department of Electrical and Computer Engineering.

Programmatic Impact

In 2000, the University created the Department of Biomedical Engineering, supported in part by grants from the Whitaker Foundation. Thanks to income from the blue noise mask, the University was able to match a Whitaker grant that was important for the growth of the department and for the construction of Goergen Hall.

Mitsa and Parker Scholarship

The Theophano Mitsa and Kevin J. Parker Scholarship Fund provides scholarships for students in the Hajim School. Established in 2011, the endowed scholarship was first awarded in 2012, and its first recipient graduated in 2014 with a degree in biomedical engineering.

In fall 1987, Mitsa set to work, reading everything she could get her hands on about halftoning and then experimenting, making run after run on Rochester's mainframe—desktop computers of the time had nowhere near the required computing power.

"Generating a good blue noise mask is a really, really tough problem that requires lots of computer time," Parker says. "Once you make a good blue noise mask, once you crack that nut, you have it. It's a set of numbers for the computer . . . it can paint-by-numbers your image really quickly and better than other halftone techniques."

Mitsa input data in the morning, letting programs run all afternoon while she went over the previous day's results, and then headed back to the computer lab in the evening to collect each day's output. "There was just tons of experimentation, tons of it," she says. "We knew we wanted blue noise and, at some point, we tried a lot of different things with blue noise."

The breakthrough happened one day in late 1988, when Parker walked into Mitsa's office brimming with excitement for an idea that he had the night before.

"Kevin walked in one morning, very excited, and said, 'I had an idea last night,'" Mitsa says. "He started drawing on the board in my office, and that pretty much was the birth of the blue noise mask because it captured the main idea."

Neither was sure the idea would work, but eventually, they developed a set of instructions contained in a 256-by-256 grid of numbers that would direct printer drivers and other software how to handle blue noise.

Because the mask was a fixed set of numbers, the computer didn't have to constantly recalculate as it created each image. That allowed images to be produced between 5 and 45 times faster than existing techniques. And, at a time when phone companies levied charges on long-distance calls and the office fax machine was an important way to send images and documents, the blue noise mask could cut long-distance fax costs by 75 percent, according to one estimate.

"If I'm to describe the blue noise mask, I'd use two adjectives: it's beautiful and it's powerful," Mitsa says. "It's beautiful because it's simple, and it's powerful because, although it's fixed, although you don't have to tweak anything in the mask for any image in the world, the blue noise mask . . . guarantees you'll get a very high-quality image."

After developing the first mask, the two continued to tweak it until they had it right. Mitsa also worked on the theory behind the mask, publishing it as part of her dissertation in 1991. "To put it in a nutshell, my PhD is actually an array of numbers, which is kind of unique and rare," Mitsa says. "It is a theory, but it's also a physical thing, an array of numbers, a fixed array."

In 1991, she and Parker published their first article outlining the work, "Digital Halftoning Using a Blue Noise Mask," in *SPIE Electronic Imaging Conference* (Vol. 1452). In 1992, the U.S. Patent Office issued patent number 5111310, "Method and Apparatus for Halftone Rendering of a Gray Scale Image Using a Blue Noise Mask," for the invention.

To Market . . . and to Court

Though Mitsa's main focus was earning her PhD, Parker understood that the advance had potentially broad commercial applications and began meeting with Research Corporation Technologies (RCT), an outside consultant that, in the early 1990s, many universities used to bring discoveries to market.

RCT Chairman and Chief Executive Officer Gary Munsinger says the advance was so technical that, at first, RCT officials didn't understand the value it might have. After the inventors explained it to them, they set to work finding licensees, a process that took a couple of years to bear fruit.

"It's only real when you start getting customers . . . happy customers, repeat customers," Parker says. "Then you really know, OK, this is actually working."

As encouraging as getting those initial customers was, it became apparent that, instead of paying licensing fees, some players in the industry went ahead and developed their own versions. RCT filed lawsuits against Epson, Lexmark, Hewlett Packard, and Microsoft, two of which went to trial and all of which were eventually settled in RCT's—and the University's—favor.

But before settlement, Parker, Mitsa, and RCT's legal team had to go through years of court action. "We had a saying, that decades come and decades go, because things just took forever," says Timothy Reckart, then an attorney for RCT and now a partner at Arizona-based Rusing, Lopez & Lizardi.

Though they're pleased at the ultimate result of the suits, Reckart says the results weren't easily achieved. Part of the challenge, he says, was translating the technology into terms judges could understand and finding experts who could testify. While the attorneys were in their element, both Parker and Mitsa say the experience was grueling.

Parker described their opponents' legal strategy as first denying any violation took place. Losing that, they would argue that the technology they used was different in important ways. Then, when RCT prevailed on those points, they'd argue that the patent was invalid, sometimes attacking the inventors' integrity to do so.

"It was just awful, quite frankly," Parker says. "The years of the infringement legal issues were not only very costly and time consuming to all parties involved, but also they were very distressing, very stressful."

But in the end, also very successful. HP settled with RCT in 1999, taking out a license to use the mask. Epson and Lexmark followed in 2001, the same year RCT filed suit against Microsoft. That case went to trial, with Microsoft prevailing in federal district court in 2005, but RCT winning on appeal in 2008 and 2010.

Whether licensed initially or only after lengthy court battles, the blue noise mask spread widely. Bobby Hunt, a retired University of Arizona engineering professor and imaging expert, says its impact has been extensive. It was in printer drivers and other software, and was important in the operation of the Internet because it cut the amount of data that had to flow over early, slow connections.

"The impact was immediate in the printer business," Hunt says. "I think virtually all computer printers use blue noise masks or something derivative from that. But there was an impact in the software business, as can be seen in the fact that Microsoft was motivated to embed blue noise masks in the generic printer driver software used for the cross-platform support of printing in all the different printers that may use Windows.

"There was also impact in the Internet. To make color images requires the transmission of color bytes over a channel. Reducing bits in transmission is important to minimizing user irritation in waiting for an image to load, as well as making more bandwidth available for data shared through the bottleneck of Internet pipes. This is particularly true for images on a cellphone, given the huge growth of smartphones that invite everyone to consume more data."

Kicking Off the 'Virtuous Cycle'

Blue noise mask licensing ultimately generated millions of dollars in royalties from licensees. After legal fees, the remainder was split between the University and RCT, with Rochester's share further split with the inventors.

Scott Catlin, associate vice president of technology ventures, says the blue noise mask was unusually successful for a faculty invention. The University gets more than 100 disclosures of discoveries from faculty each year, only a few of which ever get to market. He describes the blue noise mask as a once-in-a-decade—or more—discovery.

In an effort to encourage the next blue noise mask, the University is beefing up its technology transfer office, and has created an $800,000 fund to take discoveries through the initial steps of product development, something companies are increasingly reluctant to do, Catlin says.

"They [the companies] don't want to start from ground zero, they want you to prove that it, at some level, will be a useful product," Catlin says. "Blue noise mask is hugely valuable and important. It has produced not just money but also recognition for the University. We'd love to have more, and that's certainly the plan: to maximize opportunities."

Parker is doing his part, working to ensure the proceeds boost his envisioned "virtuous cycle." Currently the William F. May Professor in Engineering at Rochester, Parker says he became both department chair and dean in part to ensure the proceeds from the blue noise mask were used in ways that would have a positive and enduring impact on research and teaching there.

Blue noise mask revenues endowed five distinguished professorships—three in electrical and computer engineering and two in biomedical engineering. Richard Waugh, chair of the Department of Biomedical Engineering, says the money has also allowed the department to hire several junior faculty members, almost doubling the department's faculty to 15. During the same period, biomedical engineering, with more than 300 undergraduate majors, has grown to be the largest undergraduate department in the Hajim School.

"Blue noise mask is hugely valuable and important. It has produced not just money but recognition for the University. We'd love to have more, and that's certainly the plan: to maximize opportunities."
—Scott Catlin, director of technology transfer

"It came at a critical time," Waugh says. "It enabled us to reach a critical mass of faculty and grow into the department we are now."

Mark Bocko, Distinguished Professor of Electrical and Computer Engineering, says the blue noise mask funds allowed the department to expand in similar ways, from 15 to 20 faculty members, and also endowed a research initiation fund of about $50,000 per year. That money can be used to help get a project off the ground and running, to the point where it can attract government or foundation funding.

The funds were also used to match a faculty development grant from the Whitaker Foundation, which also awarded Rochester a special grant to help build the Robert B. Goergen Hall for Biomedical Engineering and Optics. The building, which is home to biomedical engineering, was named in recognition of University Trustee Robert Goergen '60, who committed $10 million for its construction.

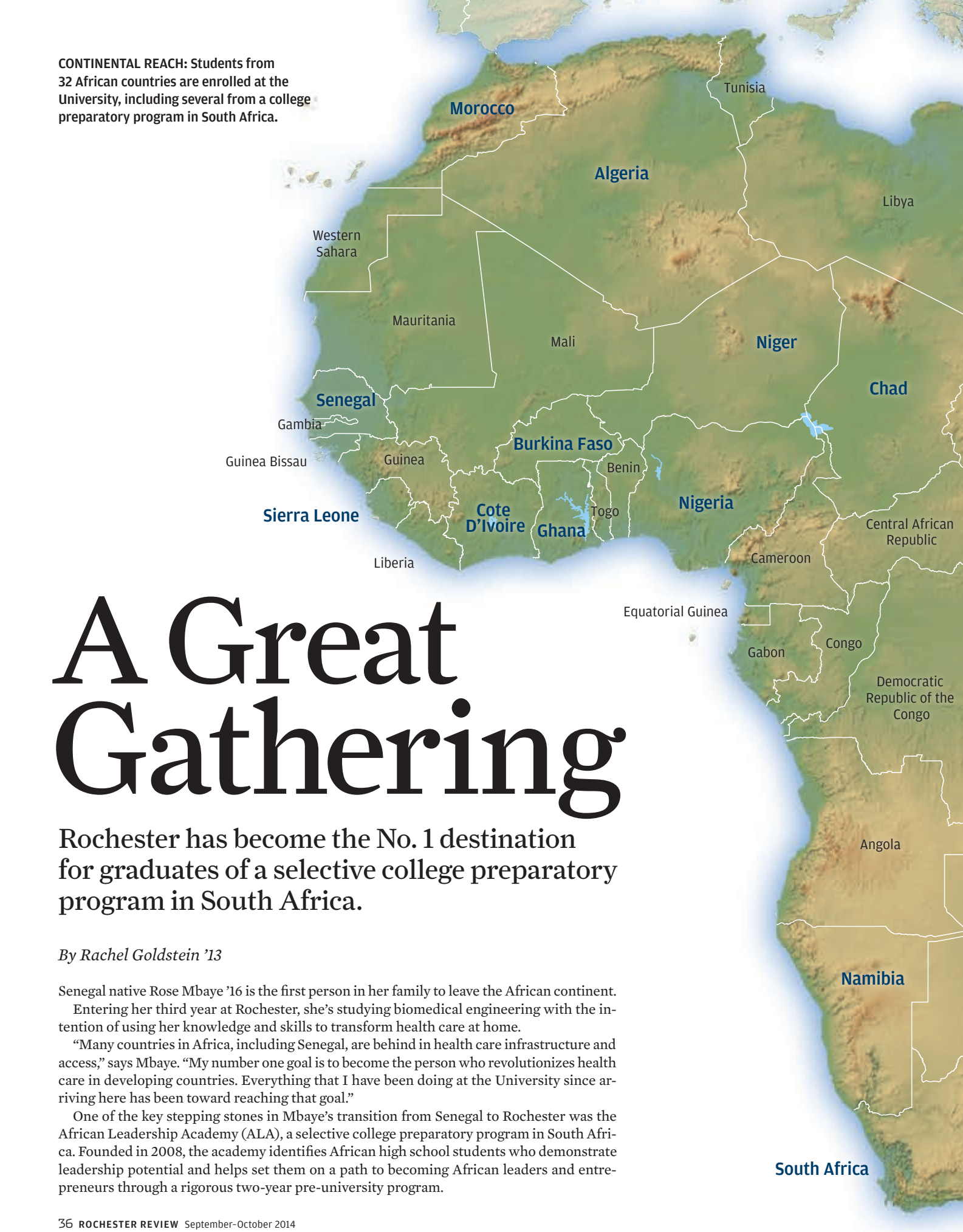
Parker himself continued to work on the blue noise mask, guiding graduate students through aspects of research. The license funding also supported work in medical imaging based on biomarkers, which created a spin-off company, Rochester-based VirtualScopics Inc.

While Parker got his virtuous cycle moving, Mitsa just got moving. She took an assistant professorship at the University of Iowa, where she shifted her focus from halftoning to data analysis in medical imaging. That led to a stint at GE Medical Imaging in Milwaukee and then to Boston, where she was on the faculty of the University of Massachusetts at Dartmouth for a time and a consultant at Harvard Medical School. Along the way, she became interested in a type of data analysis called temporal data mining and wrote the only book in the field. Today, she consults, blogs, and is at work on a second book from her home in Massachusetts.

As the blue noise mask patents expire, the peak of halftoning research has passed, Parker says. While some work continues, the enormous processing power and high resolution of current printers make the speed and quality gains from the blue noise mask less important.

"In one sense, it's like a chess game that lasted 20 years, a very complicated chess game," Parker says. "I couldn't be sure what the outcome would be, but I knew if we did everything right, we would be able to make very significant advances. Fortunately, we didn't spill the pieces on the way." R

Alvin Powell is a freelance writer based in Cambridge, Mass.



CONTINENTAL REACH: Students from 32 African countries are enrolled at the University, including several from a college preparatory program in South Africa.

A Great Gathering

Rochester has become the No. 1 destination for graduates of a selective college preparatory program in South Africa.

By Rachel Goldstein '13

Senegal native Rose Mbaye '16 is the first person in her family to leave the African continent.

Entering her third year at Rochester, she's studying biomedical engineering with the intention of using her knowledge and skills to transform health care at home.

"Many countries in Africa, including Senegal, are behind in health care infrastructure and access," says Mbaye. "My number one goal is to become the person who revolutionizes health care in developing countries. Everything that I have been doing at the University since arriving here has been toward reaching that goal."

One of the key stepping stones in Mbaye's transition from Senegal to Rochester was the African Leadership Academy (ALA), a selective college preparatory program in South Africa. Founded in 2008, the academy identifies African high school students who demonstrate leadership potential and helps set them on a path to becoming African leaders and entrepreneurs through a rigorous two-year pre-university program.

Faces of Leadership

Since its founding in 2008, the African Leadership Academy has had more than three dozen of its graduates matriculate at Rochester, more than at any other university in the world. The strong connection is an indication of Rochester's growing role as a trusted partner in African education, says Jonathan Burdick, dean of admissions and financial aid.

Eyram Adedze '17
Economics
Ghana

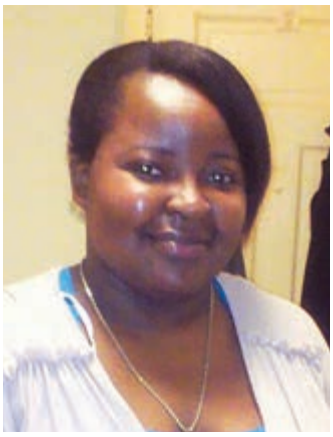
Olasunkanmi Asunmonu '17
Electrical and computer engineering/*Nigeria*

Mohammed Atul '17
Business
South Africa

Marthe Avissoudo '17
Mechanical engineering
Senegal

Samuel Barongo '14
Electrical and computer engineering/*Uganda*

Daniel Bonga '14
Electrical and computer engineering/*Sierra Leone*



Bridget Chabunya '14
Epidemiology
Malawi

Yesubet Dereje '17
Biomedical engineering
Ethiopia

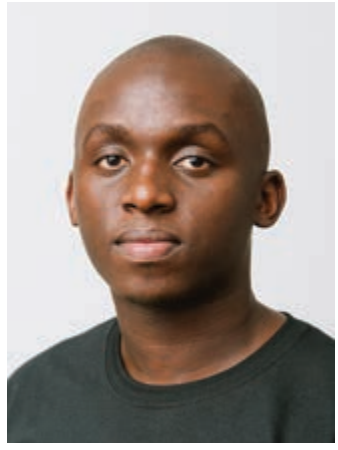
Boubacar Diallo '16
Mechanical engineering
South Africa

Abdelrahman Hassan '16
Interdepartmental studies
Egypt

Xavier Joaquinho '17
Undeclared
Mozambique

Brian Kalugira '14
Chemical engineering
Tanzania

Ntemena Kapula '18
Biological sciences
and biochemistry/*Zambia*



Bongumusa Khoza '18
Undeclared
South Africa

Many of ALA's graduates attend U.S. colleges, and about 10 percent of those graduates have enrolled at Rochester—more than at any other university in the world. In August, the University hosted ALA's fourth annual *indaba,* meaning "gathering" in Zulu—the largest conference in North America for the academy's graduates who are pursuing higher education in the U.S.

"We have become the top destination for African Leadership Academy graduates because we've not only been committed to having so many of their students, but those students also have done very well," says Jonathan Burdick, dean of admissions and financial aid at the University.

Magnifique Nsengimana '18
Audio and music engineering
Namibia

Alhassan Omar '18
Undeclared
Egypt

Zanga Ouattara '16
Computer science
Burkina Faso

Mbaye is one of 37 graduates of the academy who have enrolled at Rochester. When she first arrived at ALA, she spoke little to no English, but now speaks Wolof, her native language, French, English, and some Spanish.

She spent the summer of 2014 working at the Kwazulu-Natal Research Institute for Tuberculosis and HIV in South Africa, developing an automated image analysis program to analyze the dynamics of cells infected with a type of tuberculosis.

She also worked at the National Institutes of Health in Maryland, helping design a paper-based diagnostic device that health care clinics in developing countries could use as a low-cost, alternative technology for detecting antibody levels in the presence of infectious or autoimmune diseases.

Rose Mbaye '16
Biomedical engineering
Senegal

Caroline Modise '15
Political science
Botswana

Rafael Muchanga '18
Chemical engineering
Mozambique

Solange Munezero '17
Chemical engineering
Rwanda

Mame Coumba Mbodji '17
Mathematics
Senegal

Ngosa Mupela '16
Financial economics
South Africa

Aissalou Ndiaye '15
Biology
South Africa

Akan Nelson '15
Economics
Nigeria

Burdick says that Rochester's role in helping provide an education to students who return to their home countries makes a significant impact on African society.

"It makes a bigger difference for somebody to get an engineering degree from a place like Rochester and go back to Sierra Leone, than it does to go back to the San Francisco Bay Area," he says. "It's the same education, but the impact is significantly greater."

The first cohort of six ALA students graduated this spring, four of them with engineering degrees. One of them, Daniel Bonga '14, from Sierra Leone, plans to complete a master's degree at the University, and five have returned to their home countries.

Incoming freshman Rafael Muchanga '18, from Mozambique, is culture-shocked but excited to begin a new adventure. "I am not here just to study," says Muchanga, "but to design what I want to do and become a well-rounded, open-minded person."

The *indaba* gave him an opportunity to learn more about American culture, meet new people, and explore Rochester.

In total, the University has enrolled students from 32 different African countries, including those who have entered through other programs or on their own.

"It's all an indication of how big we've become as a trusted partner among African educators," says Burdick. "Hosting the conference is part of a larger effort to make sure we are well connected up and down the continent."

Rachel Goldstein '13 writes for University Communications.

Not pictured

Oswald Codjoe '14
Financial economics and political science/*Ghana*

Gaella Kabeya '18
Business
Zambia

Jeffrey Kanyama '17
Electrical and computer engineering/*Zambia*

Hamed Kone '15
Chemical engineering
Cote d'Ivoire

Jordan Mukisa '18
Chemical engineering
Uganda

Adil Nyambasha '18
Undeclared
Zimbabwe

Ntakamaze Nziyonvira '17
Mechanical engineering
Uganda

Kawtar Rai '15
International relations
Morocco

Ali Ramoul '15
Mechanical engineering
Algeria

Yahouza Maman Sani Sabo '18
Electrical and computer engineering/*Niger*

Siham Sh'Mumin '18
Business
Somaliland

Rodrigue Yoguelim '14
Mechanical engineering
Senegal

From the Inside, **Looking Out**

To write as an insider, novelist Stephen Schottenfeld immerses himself in unfamiliar worlds.

By Karen McCally '02 (PhD)

Huddy Marr is having a tough time of it. The protagonist in Stephen Schottenfeld's novel *Bluff City Pawn*, he's a businessman who knows his products and his customers well. And he aspires to improve his inventory, raise his bottom line, and attract a better sort of clientele.

But it's after the financial crash of 2008. He's smack in the city of Memphis, a place still haunted by the assassination of Martin Luther King Jr. And the business Huddy is in is pawnshops.

Schottenfeld, a winner of multiple awards for short stories, spent five years on the faculty of Memphis's Rhodes College before coming to Rochester in 2008. In 2013, he was named the James P. Wilmot Assistant Professor of English. Originally from tony Westchester County, New York, he's an unlikely person to write convincingly about the Southern white working class. But he approaches the world of his characters like a journalist, writing not what he knows, but what he comes to know, through immersion and deep research, and to which he brings a strong dose of empathy and imagination.

"I don't really go up and accost people on the street," says Schottenfeld, who came to know quite a few pawnbrokers before embarking on the novel, his first, which was released by Bloomsbury USA in August. "If you come in, and you're respectful, and you want to learn about their lives, most of the time they're open to talking."

The inspiration for the story came from a single street called Summer Avenue. He became acquainted with it on an exploratory drive—something he likes to do often, and did as soon as he arrived in Memphis in 2003.

"A lot of it was in disrepair," he says of the avenue and its long stretch of commercial strips. "The nicest places were fast food restaurants."

Pawnshops, check cashing joints, and used auto lots dotted the avenue.

"I like to write about work lives," Schottenfeld says. "I like the way it brings a specificity of place, a specificity of language, a kind of code that I investigate. I tell them I want to write fiction, that I'm not a journalist, which always helps actually," he says. "It makes them feel like I'm not asking for anyone's name. I'm just looking for kind of the texture of what they do."

Upon this texture, Schottenfeld invented a narrative of three brothers—the ever-striving Huddy, the itinerant Harlan, and the highly leveraged real estate dealer Joe—each of whom represents a different aspect of the economic lives of the contemporary white working class.

Schottenfeld has been praised for addressing social class tension in his work.

"I was thrilled to see that Stephen's book adopts a pawn shop proprietor as a protagonist," says novelist Anthony Doerr. "Huddy lives at the intersections between all sorts of economic classes, and his financial desperation—his yearning for a better future—is something I think a lot of Americans are feeling right now."

Schottenfeld says the characters he created are not necessarily mirrors of the people he met and talked to on Memphis's Summer Avenue. If they had been, he'd have been writing nonfiction. "I'm not a nonfiction writer," he says, adamantly. "I'm interested in getting behind what I'm seeing to some sort of fictional truth—that truth about where these characters had grown up and where Memphis was in terms of race and class; what the suburbs represented to them, and what they are."

Could he pull that off as an outsider? To Schottenfeld, that's the wrong question to ask. "Not being from the South, in writing a book like this, what I said to myself was, 'How could I live in Memphis and *not* write about Memphis?'"

Since his arrival at the River Campus, Schottenfeld has taught fiction writing and screenwriting, in addition to modern and contemporary literature. He relishes dialogue, and counts numerous playwrights—such as Harold Pinter, David Mamet, Suzan-Lori Parks, and Caryl Churchill—as among the writers he most admires.

Schottenfeld is a graduate of some of the most prestigious writing programs in the nation, including the master's program in fiction writing at Johns Hopkins and the Iowa Writers' Workshop. Yet he says he came to writing in a different way than you often hear writers describe.

"I feel like the typical writer narrative is that they were compelled to write stories to imitate this thing that they love, which is reading. Although I liked reading, it fit into a lot of other things I liked to do, like play sports and hang out with friends," he says. He didn't start "serious reading," he says, until he began taking creative writing classes in college at the University of Michigan. "In some ways," he says, "I got it all backwards."

As he was completing the final work on *Bluff City Pawn*, Schottenfeld got started on a couple of short stories. He plans another novel. "I'd like it to be about Rochester," he says.

ADAM FENSTER

STREET SMARTS: Novelist Schottenfeld pounds the pavement like an investigative reporter to gather the material he reshapes into deeply researched, character-driven stories.

Moving On Out

Huddy Marr is a family man, seeking a better life for himself, his partner, Christie, and their toddler son. But his pawnshop is in trouble. His neighbor, Mister Barnes, is moving his liquor store to a better neighborhood. And Huddy is going to have to call upon his landlord—his big brother, Joe—for a helping hand.

An excerpt from *Bluff City Pawn*, the debut novel by Stephen Schottenfeld, the James P. Wilmot Assistant Professor of English.

A hollow boom outside—Huddy jumps, the shop rattles—then screeching metal. The two sounds, explosion and collision, confuse, and Huddy waits for more noises to point it somewhere, screams or curses, horns or sirens, and when he hears nothing he rushes out to see what accident or mess. He looks to his left past the grocery that's gone, and instead of chaos and flames there's a semi in the driveway, hydraulics raised, the offloaded Dumpster behind it.

Three Mexican laborers sitting on a truck bed, a contractor at the storefront. About time, Huddy thinks. The building's been abandoned for over a year, so at least it's activity. Maybe they're putting in something helpful, like an auto-parts store, which always works perfect with a pawnshop, brings in the working man. Or maybe some neutral business, insurance, whatever, neither help nor hurt. But don't let it be public assistance—or some nightmare like a methadone clinic, addicts hanging around pissing and crapping over everything. Once that scenario pops up, Huddy finds himself walking over there just to confirm what's not going in. He goes straight to the contractor, who's posting a permit on the wall, and then he sees another worker appear in the middle doorway, a set of plans tucked under his arm, looking like the superintendent, so he slides over. "What you putting in here?" Huddy asks.

The man untucks the plans, squeezes his hands over them. "XGC Services."

"What's that?"

The man squints. "Blood bank."

Huddy's face smacked with the news. "Blood bank?" he says, just sick to repeat it. This building, long and low, same size as his own, but now it's a tower, grown colossal.

"Manny!" the man shouts, decisive. "Wreck out the front room!" He jerks his thumb behind him and Huddy watches the lead guy turn and translate instructions to the other two, who climb back to the toolbox. "Who you?" the man says, chin up-twitched, eyes fixed and narrowed.

"I run a shop next door."

The man glances to his right, eyes passing around, then back at Huddy, annoyed to have searched. "Well, I guess you're getting a neighbor."

Huddy's lips pinch together. He scans the building's three doorways, the work crew going in to start the demo. "Where's it going?"

"Everywhere," Huddy hears back. "It's the whole place." And when he looks over, the man's eyes are wide.

"We already got a blood bank downtown."

The man shrugs. "Got another one now."

JOHN W. TOMAC FOR *ROCHESTER REVIEW*


BUILDING PERMIT

"Three months," the man says casually, but to Huddy it comes out like a warning. "Gut it out, frame it. Could be six."

Huddy winces, like he's a donor getting his arm pricked without payment.

He hears the sledgehammer knocking down a partition wall.

The man's teeth flash as he watches Huddy leave. "Guess you ain't giving any blood."

Huddy thinks, Blood bank. A bunch of people with nothing. They'll hang around and harass—need a drink of water, need the bathroom, need the phone. "When's it going in?"

"Three months," the man says casually, but to Huddy it comes out like a warning. "Gut it out, frame it. Could be six."

Huddy winces, like he's a donor getting his arm pricked without payment.

He hears the sledgehammer knocking down a partition wall.

The man's teeth flash as he watches Huddy leave. "Guess you ain't giving any blood."

Half of his meal uneaten, but Huddy can't touch it. It'll take less than a week after the bank's opened before it's wall to wall in there. And then they'll be here. On a rainy day, a crowd's gonna be all up under his canopy. Two hookers stroll by, one in red spandex, bright and tight; the other in jeans, whale-tail underwear peeking out the back. A car honks, hips sway and turn, but the driver doesn't stop, was only teasing.

He calls home again.

"Huddy, what you doing? It's naptime." Christie whispering mad.

But the clock says earlier. "I thought I was calling before that."

"I put him down an hour ago. The time change."

He shakes his head, forgot. "Why didn't you turn the ringer off?"

"I left it on, in case Harlan called. Was he in Florida last night or did he call you from the road?"

"They're putting a blood bank in the next building."

"Damn, he's getting up. He's always up."

Customer comes in. "I gotta go," Huddy says.

The man dragging his way over to the counter. He holds out a necklace that's all kinked and damaged.

Huddy gets the scale, weighs it. Six pennyweights. "I can give you forty bucks."

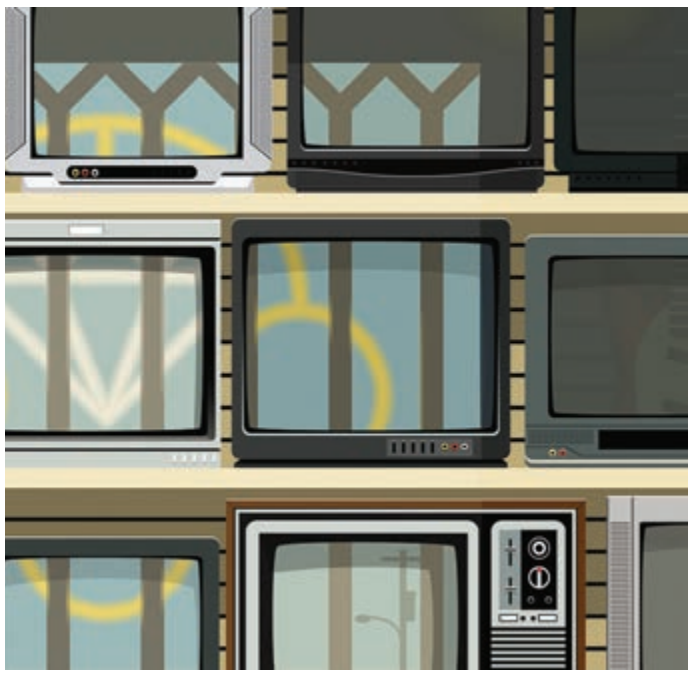
"Forty?"

"This has no value as a necklace. I can only sell its weight. It's not a necklace anymore."

"Come on now." The man flings out a hand and glares. Points at the necklace like it was fine jewelry until Huddy smashed it and cheated with the scale. "That's more than forty."

"Not from this side of the counter," Huddy says and he pushes the scrap back. "Thanks for stopping in." The man's anger spreads to confusion, then grief. "Maybe you got something else you can bring me," Huddy says, and the man nods, slips inside himself, "Yeah, okay, might."

Huddy wants to shut the door and unplug the phone and think about his worries—Barnes plus blood bank—figure out how to tell them both to Joe. He calls Joe, gets the voice mail, hangs up, tries the office, gets the secretary: "Do you want his voice mail?"



"Just tell him … not to forget about my lights." But that's not enough of his worry anymore. *Tell him I'm tired of him getting his rent but me not getting my living.* Joe with his monthly rent and his weekly cash. And his shopping sprees, cherry-picking the best jewelry from the showcases, only paying cost so Huddy can't make a profit. Just saying, "Book it," then stepping to the back to tape his name on sale items that haven't cleared thirty days.

Huddy frowns at the bulky analog TVs on the shelf. He's in no man's land with televisions; the flats ain't coming in yet, and he's stuck with those.

Then a lever-action collector comes in, mentioning the L.C. Smith double-barrel he's just seen at Liberty Pawn, over on Summer, a gun he knows Huddy would want for himself. "Your eyeballs gonna jump when you see it. Man named Keller—he's got it locked away 'cause he ain't letting the yahoos play with it. It's so clean and smooth, you gonna think it's a reproduction." Huddy decides to close up and chase down a special gun. Ⓡ

JOHN W. TOMAC FOR *ROCHESTER REVIEW*