Virologist and HIV Expert Michael Emerman Retires

A pioneer in the field of paleovirolgy, Emerman considers mentorship his most important duty in science. Here's more about his career.

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During his 36-year career at Fred Hutch Cancer Center, Michael Emerman, PhD, made fundamental discoveries about HIV, the retrovirus that causes AIDS.

He and Fred Hutch evolutionary biologist Harmit Malik, PhD, made a new field of research — paleovirology — which traces the effects of evolutionary battles with ancient pathogens that have shaped our modern, innate immune systems.

But above all, Emerman made scientists — generations of graduate students who took his popular virology course as well as the graduate students and postdoctoral researchers he mentored in the lab, helping them find their way in science and in life.

He won the KT Jeang Retrovirology Prize in 2017 and was invited in 2020 to give the Bernard Fields Lecture at the Conference on Retroviruses and Opportunistic Infections as well as the keynote talk this year at the 50th anniversary of the annual Cold Spring Harbor Laboratory Retrovirus Meeting.

His longtime collaborator and fellow virologist and HIV expert in the Human Biology Division, Julie Overbaugh, PhD, acknowledged those achievements at his recent retirement party as well as his extraordinary devotion to teaching, which figures as prominently in his legacy as his pioneering research in virology and HIV biology. Overbaugh holds the Endowed Chair for Graduate Education.

"I believe you are the most impactful faculty member ever at Fred Hutch for graduate education," Overbaugh said, following a long line-up of former students who also took turns at the microphone sharing memories and warm wishes.

Answering the Call to Help

Born in Columbus, Ohio, Emerman attended Ohio State University, intending to major in chemical engineering.

"A lot of my friends' dads were all engineers and that sounded like a good thing," Emerman said.

But he discovered that biology intrigued him more, especially evolution and genetics, because those disciplines allowed for more than one solution to a problem, reflecting the wondrously creative engineering of life itself.

In 1981, he began a PhD program at the University of Madison-Wisconsin, joining the lab of a virology legend, Howard Temin, PhD, who won the Nobel Prize in 1975 with David Baltimore, PhD, and Renato Dulbecco, MD, for the discovery of reverse transcriptase, the enzyme that converts RNA into DNA and enables viruses to integrate their RNA into the DNA of host cells.

Temin challenged his graduate students to conceive and execute their own projects, helping when he could, but he didn't do his students' thinking for them, a teaching philosophy Emerman emulated later with his own students.

In Temin's lab, Emerman developed an expertise in retroviruses, a family of RNA viruses that uses reverse transcriptase.

Meanwhile, the first AIDS cases were emerging in California and New York.

By the time Emerman completed his PhD in 1986, he knew where he wanted to go for his postdoctoral training: the Pasteur Institute in Paris, to study with the French virologist Luc Montagnier, who had isolated the retrovirus HIV-1 as the cause of AIDS, winning him a share of the Nobel Prize in 2008.

"My feeling was: I have an expertise in retroviruses. We have a pandemic. I can do something that can help," Emerman said. "At that time, most people working on HIV biology could fit in one room."

HIV-2 had been isolated when he arrived in Paris, and he joined the effort to compare its biology to HIV-1 as well as other projects.

"What I learned in Paris was to collaborate," Emerman said.

As an outsider, Emerman was not immersed in the highly competitive and proprietary culture of the institute, which gave him more intellectual freedom to share ideas and learn from people with different expertise in different labs. He also edited his colleagues' papers for English-language journals.

"I was kind of involved in everything," Emerman said. "I would go around and talk to everyone."

He sometimes answered the calls of desperate people asking if he and his colleagues were any closer to discovering something about the virus that could give people with AIDS hope.

"People were dying all the time, and there was nothing we could do for them," Emerman said during his keynote address this year at Cold Spring Harbor Laboratory in New York. "People would call the Pasteur, and they would give me the phone because I spoke English better, and it was just

sad. People would ask me is there a new thing? And there wasn't. There wasn't anything. It was a bleak time."

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Giving Stuff Away

In 1989, Emerman was hired at Fred Hutch, which had recently been awarded a program grant from the National Institutes of Health to build a biosafety level 2/3 lab to work with infectious HIV.

"We recruited Michael around the same time to really spearhead that," said Adam Geballe, MD, former associate director of the Human Biology Division at Fred Hutch.

When he arrived at his lab in the original Fred Hutch building in Seattle's First Hill neighborhood, he found it empty except for a chair and a telephone (the desk was too wide to fit through the door).

He also found Fred Hutch to be less fussy about hierarchy than the Pasteur Institute.

Ideas came from the bottom up rather than the top down and one could chat with the president while waiting in line for coffee.

"The Hutch was a very flat place," Emerman said.

Early in his career at Fred Hutch, he invented a faster way to count infected cells that was distributed to more than 500 labs in more than 30 countries. He shared that assay, along with other reagents and vectors his lab produced over the years, which marked a generational shift in a field that had traditionally operated with tighter control over tools, techniques and ideas.

Emerman found more value in sharing.

"You give away ideas, you get ideas back; you hold back ideas, you don't get any ideas," he said. "All the informal collaboration is about giving away stuff: both ideas and reagents."

He used that assay to solve a riddle. Temin's early work had shown that retroviruses required cell division, or mitosis, to infect their hosts, but HIV was different — it could infect nondividing white

blood cells of the immune system — which set off a long series of projects from many labs to find out how.

Emerman and Masahiro Yamashita, a postdoctoral researcher in his lab, eventually found in a breakthrough paper in 2004 that HIV relies on a key structural protein that makes a protective shell called a capsid around the viral RNA and the enzyme that converts it into DNA.

Before the shell disintegrates like the gel coating on a pill, it interacts with proteins on the surface of the nucleus and smuggles the protected genetic material across the barrier, fundamentally changing the white blood cell it's infecting.

Founding a New Field of Research

Emerman had been hired into a program at Fred Hutch called Molecular Medicine, which was created to bridge the Basic Sciences Division and the Clinical Research Division and was folded into a new research division called Human Biology in 1998.

But as a condition of employment, Emerman asked for an additional appointment to Basic Sciences and retained voting status in both Basic and Human Biology for the duration of his career, regularly collaborating with his colleagues in both divisions.

"People are expected to collaborate. It's one of the things we look at when we promote people," Emerman said. "Who are they working with? Who are they helping? It's something very special about this place. A lot of places don't do that. I could tell that when I interviewed here."

In Human Biology, he collaborated most with Overbaugh, who focuses on people particularly vulnerable to HIV: commercial sex workers and HIV-positive mothers and their infants in Kenya.

"This is a good collaboration because she thinks of things from the clinical side, from the top down. I think of things from the molecular side, from the bottom up," Emerman said.

His collaboration with Malik in Basic Sciences founded a new field of research.

They joined forces after Emerman spoke at a faculty retreat about a molecular battle between defense mechanisms that human cells produce called host restriction factors, which make it harder for HIV to replicate and spread, and proteins the virus deploys to defeat them.

After completing his postdoctoral training at Fred Hutch, Malik had just opened his own lab focusing on how conflicts between genes with opposing functions shape their evolution.

Malik proposed that the two labs work together to investigate one of those interactions throughout primate evolution for signs of an "arms race" between viruses and host proteins.

A postdoctoral researcher in Malk's lab, Sara Sawyer, PhD, led the investigation, tracing the genetic history of the restriction factor across 10 primate species, showing that its arms race with

viruses had been raging for at least 33 million years.

“This led to this idea that we can use evolution to trace the ancient and modern origins of HIV-1,” Emerman said.

They published the results in 2004, the first of 33 co-authored papers they have published since then, launching a new research specialty Emerman dubbed paleovirology.

“The field was really hungry for something like this,” Malik said. “The insight that Michael and I had was that in addition to this fossil record, we had the evolutionary echoes of past infections by the imprints that they left on the host antiviral genes that had adapted. Even in the absence of knowing what pathogen actually caused that infection, we could use the evolutionary echo to infer what the viruses must have been like and what properties they had.”

Keeping the Flag Flying High

Collaboration didn’t mean automatic consensus, however.

“Harmit is a great collaborator because we don’t agree about anything,” Emerman said. “Every result, we interpret it differently and we say what we’re going to do differently. But we do agree that we are eventually going to agree. We listen to each other. Sometimes we change sides, and I start arguing what he thought, and he starts arguing something I thought.”

Sawyer, now a virologist at the BioFrontiers Institute of the University of Colorado, Boulder, was the first of six postdoctoral researchers Emerman and Malik co-mentored, plus another dozen graduate students.

“We’ve trained some amazing people who are trained both in evolution and virology and they’ll keep the flag flying high,” Malik said.

Their students often found themselves whipsawed between two scientists with two different ways of thinking about things, which could be frustrating and required many revisions of a paper before it was ready for publication.

“The reason it works is that we always agree in the end,” Emerman said. “We agree we’re going to do what’s best for the student and we trust each other.”

Malik learned a lot about running a lab by watching Emerman.

“Some people are very successful and very unhappy — misery is almost considered an important ingredient for success,” Malik said. “Or they’re very happy, but pretty ordinary.”

Emerman’s lab was happy and produced extraordinary work.

Malik marveled at how Emerman empowered his students to own their own projects and discover their own passions and aptitudes rather than impose his will on their ambitions.

“I’ve had goosebumps being the third person in that conversation,” Malik said. “It’s the biggest high you can get in this business.”

Mentoring the Next Generation of Scientists

In 2012, Emerman’s trainees nominated him for the McDougall Mentoring Award, which remains his proudest accomplishment.

His devotion to teaching reached beyond his own lab, both formally and informally.

Emerman co-directed the Molecular and Cellular Biology (MCB) Program, jointly offered by Fred Hutch and the University of Washington, from 2006–2014. He developed and taught the Human Pathogenic Viruses graduate course — a popular MCB course enrolling 30 to 40 students in each class he taught from 2006 until 2023.

He mentored 26 PhD students, and nearly all of them are still working in science careers (one went to law school). He served on more than 100 graduate thesis committees.

Much of his teaching with students and colleagues alike happened in less formal settings, including at an annual retreat as part of a viral pathogenesis training grant. “Michael would always come up with virology trivia,” said Denise Galloway, PhD, holder of the Paul Stephanus Memorial Endowed Chair.

“We would get randomly assigned to these different tables and we’d all get a sheet that had 10 or so questions,” she said. “It was a lot of fun, and Michael was always the creator of it.”

Beginning in 1992, Emerman organized Thursday morning virology group meetings, which provided graduate students and postdoctoral researchers an opportunity to present their research, polish their presentation skills and challenge each other to evaluate research critically and meet potential collaborators.

“Many students when they graduate, they thank the Thursday morning group because it’s just a very open discussion kind of forum, really the best of Fred Hutch. He’s led that for a long time.” Geballe said.

Emerman often ate lunch with his students in the courtyard between the Basic Sciences and Human Biology buildings and led an annual team-building hike with his lab members, making sure it was no more difficult than what the least athletic among them could manage.

He commuted to Fred Hutch by bicycle every day, rain or shine, as well as riding onto the

Bainbridge ferry for faculty retreats, cruising past his colleagues waiting in their cars to board.

Emerman's colleagues nominated him this year for the Fred Hutch Conclave Award for Education, Training, and Mentorship, which he received at the third annual celebration of contributions and accomplishments of faculty representing integrated research and clinical enterprise.

Overbaugh wrote in her nomination letter that her own students have relied on Emerman for advice.

"Sometimes when a student is stuck, I suggest they talk to Michael," she wrote. "Sometimes it is to take advantage of his keen scientific insights, but just as often it is to take advantage of his unfailing support. Finally, I must say how important Michael's mentoring has been to me personally. He is the first person I go to when a student is struggling."

Learning How to Teach

Emerman maintained a prominent profile in the field of virology, including serving as editor in chief of the journal Virology.

This year, he was asked to give the keynote address at the 50th anniversary of the annual retrovirus meeting at Cold Spring Harbor Laboratory where he reflected on his 43 years in the field.

This was also the 50th anniversary of the Nobel prize that Baltimore and Temin, who died in 1994 of lung cancer, won for the discovery of reverse transcriptase in 1975.

Emerman, now an emeritus professor, titled the final section of his talk: "What is important to me in my science career."

"Mentoring is the most important thing I do," he said.

He said that although he trained with two Nobel laureates, he had to learn how to be a good teacher on the job.

After reading student course evaluations complaining that he tended to answer his own questions in class without giving students a chance to respond, he learned to speak less and patiently wait for students to speak more.

"That's how I learned how to teach a good course: by teaching a really bad course," Emerman said.

In individual meetings with students, Emerman famously allowed an uncomfortable silence to deepen between them until the student couldn't stand it any longer and started thinking out loud.

"Things might go slower if I don't tell you what to do, but eventually you are going to learn if I

don’t tell you,” Emerman said. “You tell me, and then I tell you what I think about it.”

He also reflected on what he’s learned about how to persevere when the U.S. government’s historic commitment to scientific research has suddenly been cast into doubt.

“It was a dark time in the ’80s,” Emerman said. “There was no money for HIV. People were afraid of everything. Starting my lab, people would not go up to my floor.”

But he cautioned against despair.

“We’ve been through hard times before,” he said. “Advocacy led to us getting over that, to getting funding up, to eventually leading to discoveries,” he said. “We are not stuck, and we are not powerless.”

Constantly saying goodbye

Many of his former students spoke at Emerman’s retirement party on a bright and breezy afternoon at The Center for Wooden Boats in sight of the Fred Hutch South Lake Union campus.

Caroline Langley, a previous graduate student in the Malik and Emerman labs, recounted attending another retrovirology conference at Cold Spring Harbor Laboratory and taking comfort in learning that Emerman would be there, too.

“We were all so grateful. This conference is so intimidating,” Langley said. “We walk in and within 15 seconds, he hadn’t even got his badge yet, he was swarmed. He was like an A-list celebrity. He was like a new pope in Vatican City.”

She also recalled what he told her when she stopped by his office for a tearful farewell to her teacher on her last day.

“Michael, I don’t know how you do this job. I feel like you’re constantly saying goodbye,” she said.

“And without missing a beat he said: ‘No, Caroline. That’s the best part. I get to watch you all go on to do bigger and better things.’

“So now, Michael, as you are stepping into your retirement it’s our turn to return the sentiment to you.”

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