

MATEMÁTICOS ACTUALES

Edray Herbert Goins, Teoría de números, geometría algebraica

Edray Herber Goins nació en el centro-sur de Los Ángeles y, teniendo en cuenta el reconocimiento que figura en el encabezamiento de su tesis, este matemático parece haber sido orientado por su madre, Eddi Beatrice Goins, y también por su padrino, William Herber Dailey. Él escribe esto:

Al autor le gustaría dar el máximo crédito a su madre, Eddi Beatrice Goins, y a su padrino, William Herber Dailey, por su constante orientación, apoyo y protección a lo largo de los años.

Edray Goins fue criado junto con su hermano. Del resumen de la charla "*Black Mathematician: My Journey from South Central to Studying Dessins d'Enfants*" que dio en 2015 en la Universidad de Michigan, en el "Coloquio del Dr. Marjorie Lee Browne" obtenemos los siguientes detalles. En 1939, Annie Beatrice Brown dio a luz en Marshall, Texas, a Eddi Beatrice Brown. Pasó la mayoría de los años 1936-1942 tomando clases de educación en Bishop College, alternando su tiempo entre tomar clases de educación y ser una madre que se queda en casa. Eddi Beatrice Brown se convirtió en maestra, se casó con Goins, y en 1972 dio a luz a Edray Herber Goins, el protagonista de esta biografía, en el centro-sur de Los Ángeles.

Edray siempre ha dicho que su madre y otros maestros en el sistema de Escuelas Públicas Unificadas de Los Ángeles, a las que él asistió, le alentaron y motivaron a estudiar mucho y asumir desafíos de aprendizaje adicionales [Referencia 9]:

Incluso a temprana edad, Edray mostraba sed de conocimientos. Pidió a sus maestros que lo dejaran estudiar con anticipación, o bien conocer asignaturas que no formaban parte del plan de estudios.

Tuvo mucho éxito en la escuela secundaria y en 1989 ganó la Medalla de Bronce en Matemáticas del Decathlon Académico de Los Ángeles.

La prueba preliminar de evaluación escolar en el momento en que Goins estaba en la escuela secundaria consistía en una sección de matemáticas y una sección verbal. La National Merit Scholarship Corporation estableció el Programa Nacional de Becas de Logro en 1964 que tiene como objetivo reconocer a los estudiantes negros destacados de la educación secundaria de los Estados Unidos. Los estudiantes negros pueden ingresar tanto en este programa como en el programa National Merit al realizar el Examen Preliminar de Evaluación Escolar. En 1989, a Goins se le otorgó una Mención de Honor de la National Merit Scholarship, y al año siguiente se graduó en el High School y recibió una National Achievement Scholarship. Esta no fue la única beca que recibió antes de ingresar al Instituto de Tecnología de California, Pasadena, California, ya que en 1990 también recibió una beca Roy A Wilkins de la Asociación Nacional para el Avance de las Personas de Color, una beca Sigma Pi Phi y un Robert A Millikan Physics Scholarship del Instituto de Tecnología de California.

En el Instituto de Tecnología de California se dio cuenta rápidamente de que quería ser investigador de matemáticas. Él dijo [Referencia 4]:

Sabía desde una etapa bastante temprana de mi vida, desde mi primer año de universidad para ser exactos, que quería ser matemático de investigación.

Mostró sus habilidades desde su primer año, recibiendo el Premio Morgan Ward de Matemáticas tanto en 1991 como en 1992. El Instituto de Tecnología de California brinda la siguiente información sobre este premio:

El Premio Morgan Ward fue establecido por el Departamento de Matemáticas en 1963 para honrar la memoria del profesor Morgan Ward en reconocimiento a su largo servicio a las matemáticas y al Instituto. La competencia está abierta a todos los estudiantes de primero y segundo año, independientemente de los principales. Una entrada consiste en un problema matemático junto con una solución o una contribución significativa hacia una solución. ... La solución al problema puede tener cualquier fuente, pero esta fuente debe indicarse en la entrada. Las entradas pueden juzgarse en función de la naturaleza del problema, la originalidad y la elegancia de la solución.

También ganó una beca de la American Physical Society de 1991-92. En Physics Today (noviembre de 1991) se dan detalles de estas becas:

La American Physical Society ha otorgado becas patrocinadas por empresas para el año académico 1991-92 a 22 estudiantes minoritarios que se especializan en física. ... Las becas se otorgan a estudiantes afroamericanos, hispanos o nativos americanos que son estudiantes de último año de secundaria o estudiantes de primer año o segundo año de universidad. Las selecciones se basan en calificaciones académicas y logros, declaraciones personales ... y cartas de referencia. Cada beca consta de 2000 dólares, que se pueden usar para matrícula, alojamiento y comida, y se pueden renovar una vez.

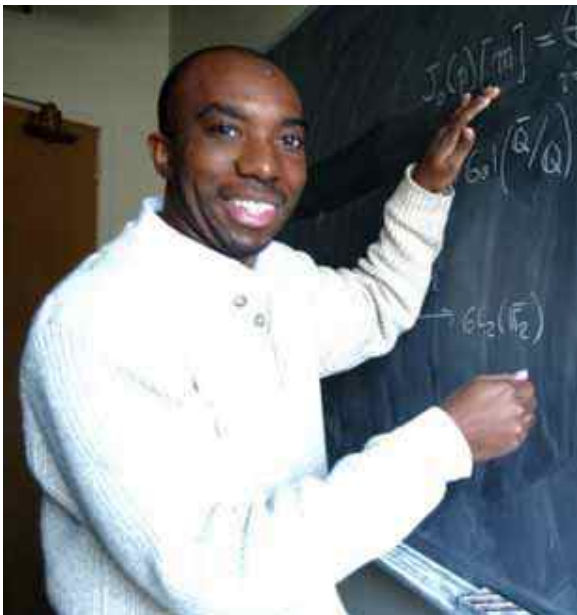
De hecho, la beca de la American Physical Society de Goins se renovó para el año 1992-93. También en 1993 se le otorgó una beca de la Fundación Filantrópica de Los Ángeles que es para estudiantes que necesitan ayuda financiera y participan en actividades escolares extracurriculares y servicio comunitario. En el Instituto de Tecnología de California, Goins fue asesorado por el profesor de matemáticas Dinakar Ramakrishnan y el profesor de física teórica Steven C Frautschi. En junio de 1994, Goins se graduó con un B.S. especializándose en Matemáticas y Física. Había ganado varios premios durante sus años de pregrado en el Instituto de Tecnología de California, a saber, la Dean's Cup for Service (1993), el Doris S Perpall Speaking Award a la mejor presentación en Humanities (1993) y el Rodman W Paul History Prize (1994).

En 1994, Goins recibió una Beca de Investigación de Graduados de la Fundación Nacional de Ciencias (Mención de Honor) y una Beca de Graduados del Consorcio Nacional de Ciencias Físicas que le permitió comenzar la investigación para un doctorado. en la universidad de Stanford. Durante los veranos de 1995 y 1996 realizó una pasantía de verano de junio a agosto en la Agencia de Seguridad Nacional, Fort George Meade, Maryland. En 1996 se le otorgó el Premio al Estudiante Graduado Sobresaliente del Centro de Servicios Comunitarios Black, Universidad de Stanford. Sus asesores de tesis en Stanford fueron Daniel Willis Bump y Karl Cooper Rubin. En 1999 recibió una serie de premios y honores de la Universidad de Stanford por sus destacadas contribuciones: el Premio James W Lyons al Servicio, Universidad de Stanford; el Premio al Servicio de Graduados, Consejo de Estudiantes Graduados, Universidad de Stanford; y el destacado estudiante de posgrado, Asociación de Estudiantes de Posgrado Chicano/Latino,

Universidad de Stanford. Obtuvo el doctorado (Ph.D.) en septiembre de 1999 por su tesis *Curvas elípticas y representaciones icosaédricas de Galois*. Goins da los siguientes reconocimientos en su tesis:

El autor desea agradecer a su asesor, Dan Bump, por sugerir el problema original; su co-asesor no oficial Karl Rubin por sus invaluable sugerencias y la comprensión de que la curva elíptica es isógena a su conjugado; y al estudiante graduado William Stein por su ayuda en el cálculo de coeficientes a través del algoritmo de símbolo modular de Cremona. Esta tesis no podría haberse completado sin su ayuda. El autor también quisiera agradecer a las siguientes personas por conversaciones útiles: David Carlton, Jordan Ellenberg, Ralph Greenburg, Kenneth Ribet y Richard Taylor. Los documentos de Ki-ichiro Hashimoto y Yuji Hasegawa también fueron útiles para obtener información sobre las propiedades de las curvas Q . Toda la investigación fue patrocinada por una beca generosa del Consorcio Nacional de Ciencias Físicas (NSPC) y la Agencia de Seguridad Nacional (NSA).

Aunque la fecha en que presentó su Ph.D. La tesis se muestra claramente en una copia en la web como "agosto de 1999" y "Copyright por Edray Herber Goins 1999", la Universidad de Stanford tiene una copia de la tesis en su sitio web con fecha "octubre de 2002" y tiene "Copyright por Edray Herber Goins 2003". Esto es desconcertante, pero la fecha de 1999 seguramente es correcta, ya que esa copia tiene las firmas de los examinadores, mientras que la copia de 2002 no. En su tesis, Goins examinó los casos de la Conjetura de Artin y presenta los antecedentes al comienzo de la tesis:



En 1917, Erich Hecke probó una serie de resultados sobre ciertos caracteres que ahora se conocen comúnmente como caracteres de Hecke; un corolario establece que las representaciones complejas unidimensionales de Galois dan lugar a toda la serie L. Reveló, a través de una serie de conferencias en el Instituto de Estudios Avanzados de Princeton en los años siguientes, la relación entre representaciones tales como generalizaciones de caracteres de Dirichlet y formas modulares como las funciones propias de un conjunto de operadores de conmutación autoadjuntos. Muchos matemáticos se inspiraron en su visión innovadora y su novedosa prueba de la continuación analítica de la serie L y su ecuación funcional. En la década de

1930, Emil Artin conjeturó que una generalización de tal resultado debería ser cierta; es decir, las representaciones proyectivas complejas irreducibles de grupos de Galois finitos también deberían dar lugar a toda la serie L. Llegó a esta conclusión después de probarse a sí mismo que tanto las representaciones tridimensionales como las 4 dimensiones del grupo simple de orden 60, el grupo alterno A_5 , dan lugar a la serie L con singularidades. En el espíritu de Hecke, formuló su conjetura en términos de la continuación analítica de la serie L y su ecuación funcional. Es sabido, debido a la percepción de Robert Langlands en la década de 1970 que relaciona los caracteres de Hecke con la teoría de la representación, que para probar la conjetura es suficiente demostrar que tales representaciones son automorfas. Esta conjetura ha sido la motivación para

muchos estudios tanto en teoría de números algebraicos como en teoría analítica de números desde entonces.

En agosto de 1999 pasó un mes como Investigador del Instituto de Ciencias Matemáticas en Berkeley, California, y luego, en septiembre de 1999, se convirtió en becario postdoctoral en el Instituto de Estudios Avanzados, Princeton, Nueva Jersey, ocupando este puesto hasta agosto de 2000, siendo desde abril de 2000 profesor visitante en la Universidad de Harvard. Después del tiempo de permanencia en Princeton, regresó a Berkeley en agosto de 2000, donde nuevamente fue becario postdoctoral hasta diciembre de 2000, pasando octubre de 2000 como profesor visitante en la Universidad de Purdue. Pasó de enero de 2001 a junio de 2001 en el Max Planck Institut für Mathematik en Bonn, Alemania, regresando a los Estados Unidos para ocupar el puesto de Instructor de Matemáticas de la Fundación Irvine en el Instituto de Tecnología de California en Pasadena en agosto de 2001. Continuó ocupando esta Instrucción hasta agosto de 2003, aunque pasó desde septiembre de 2001 a junio de 2002 como profesor visitante en la Universidad de Harvard. Permaneciendo en el Instituto de Tecnología de California en Pasadena, fue designado como Instructor de Matemáticas Taussky-Todd en septiembre de 2003. En enero de 2004 apareció en *Black Issues in Higher Education* como uno de los "Eruditos emergentes del año 2004". Mostró que merecía este honor cuando en agosto de 2004 fue nombrado profesor asistente de matemáticas en la Universidad de Purdue en West Lafayette, Indiana.

Los primeros dos artículos de Goins aparecen en el libro *African American Researchers in the Mathematical Sciences*. Vol. III, que fue publicado por la American Mathematical Society en 2001. El libro contiene documentos de la 3ra Conferencia para Investigadores Afroamericanos en Ciencias Matemáticas celebrada en la Morgan State University, Baltimore, MD, del 17 al 20 de junio de 1997 y la 5ta Conferencia celebrada en la Universidad de Michigan, Ann Arbor, MI, del 22 al 25 de junio de 1999. Uno de los dos documentos es *The fractional parts of n/k* escrito conjuntamente con MR Currie y el otro es *Artin's conjecture and elliptic curves*. Como el primero de ellos da la dirección de Goins como la Universidad de Stanford, mientras que el segundo da su dirección como Instituto de Estudios Avanzados de Princeton, conjeturamos que el primer documento se presentó en la conferencia de 1997, mientras que el segundo se presentó en la conferencia de 1999. El papel de la conjetura de Artin y las curvas elípticas contiene algunos resultados de su tesis.

Varios de los trabajos de Goins son particularmente atractivos y muchos de los problemas que se estudian son comprensibles sin un conocimiento profundo de las matemáticas. Por ejemplo, su artículo de 2006 *Heron triangles via elliptic curves* (escrito con Davin Maddox) tiene una revisión que comienza así:

Un triángulo de Heron es un triángulo cuyos lados a , b , c y área n son todos números racionales. En este delicioso artículo, los autores analizan la siguiente pregunta: Dado n , ¿cómo podemos decidir si existe un triángulo de Heron de área igual a n ? Esta pregunta es similar al problema del número congruen-



te, que pide determinar, dado n , si hay un triángulo pitagórico con lados racionales y área n .

El resumen del documento establece:

Dado un número entero positivo n , uno puede preguntarse si hay un triángulo rectángulo con lados racionales que tengan área n . Dichos enteros se denominan números congruentes y están estrechamente relacionados con las curvas elípticas de la forma $y^2 = x^3 - n^2x$. En este artículo, generalizamos esta idea y mostramos que existe una correspondencia entre enteros positivos n asociados con triángulos arbitrarios con lados racionales que tienen área n y la familia de curvas elípticas $y^2 = x(x - n\tau)(x + n\tau^{-1})$ para τ racional distinto de cero.

Otro artículo encantador es el publicado por Goins con el nombre *Palindromes en diferentes bases: una conjetura de J Ernest Wilkins* (2009). Citamos una reseña de Clemens Fuchs:

En este entretenido artículo, el autor demuestra que existen exactamente 203 enteros positivos N , que están todos explícitamente listados, de modo que N es un palíndromo en base 10 con $d \geq 2$ dígitos ($d=1$ sería trivial) y N es al mismo tiempo un palíndromo con d dígitos en una base $b \neq 10$. El más pequeño de estos N es 22, el más grande es 9986831781362631871386899, y los posibles valores de d son: $d = 2, 3, 4, 5, 6, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25$. Esto verifica una conjetura de J Ernest Wilkins de que no existe tal N con 8 dígitos y que los únicos d pares para los que existe tal N son $d = 2, 4, 6$. El resultado se obtiene de dos lemas simples (ambos sugeridos por Wilkins) y una exhaustiva búsqueda por computadora de fuerza bruta implementada en 'Mathematica'. Se proporciona el código de la computadora y la lista completa de resultados. La búsqueda paralela en veinte procesadores tomó unos quince meses. El artículo termina con un problema abierto para futuras investigaciones.

Goins recibió muchas becas de investigación, la mayoría con el tema de promover la participación matemática de grupos minoritarios. Por ejemplo, las conferencias 'Purdue Research in Mathematics Experience (PRiME)' trajeron:

... oradores externos, mujeres de color en las ciencias matemáticas, para hablar sobre su viaje profesional de ser una estudiante de pregrado a ser miembro del profesorado.

Un objetivo de la conferencia Simposio de estudiantes subrepresentados en topología y investigación de álgebra en 2013 fue reunir a jóvenes investigadores en álgebra y topología de diversos orígenes y exponer a estudiantes universitarios a oportunidades de investigación. Los subsidios ganados por Goins en 2016, 2017 y 2018 organizaron conferencias con el objetivo de "producir una fuerza laboral matemática profesional más diversa".

En 2018, Goins publicó el fascinante artículo *Tres preguntas: El viaje de un matemático negro*, en el que escribe [3]:

Soy el presidente de la 'Asociación Nacional de Matemáticos', una organización profesional que busca aumentar la conciencia pública sobre temas de importancia para las minorías subrepresentadas en las ciencias matemáticas, y me gustaría modificar estas preguntas y hacerle lo siguiente:

¿Cuántos matemáticos afroamericanos te has graduado?

¿Cuántos matemáticos afroamericanos ha contratado?

¿Por qué?

Puede leer al final de esta biografía una versión de ese artículo, en el que explica por qué en su viaje personal para convertirse en profesor titular estas preguntas fueron tan importantes.

Poco después de escribir este artículo, Goins renunció a la Universidad de Purdue y aceptó un puesto en el Pomona College a partir de julio de 2018. Explicó su decisión en varios artículos y entrevistas, por ejemplo en [4]. El artículo [5] *Para un matemático negro, Cómo es ser el 'único'* (*For a Black Mathematician, What It's Like to Be the 'Only One'*), publicado en The New York Times en febrero de 2019, analiza la decisión y los comentarios vertidos sobre la decisión de Goins, tanto positivos como negativos. Más adelante, puede leerse una versión de este artículo, a continuación del anterior.



Basado en el artículo de JJ O'Connor y EF Robertson
<http://www-history.mcs.st-and.ac.uk/Biographies/Goins.html>
casanchi.com

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3. E H Goins, Three Questions: The Journey of One Black Mathematician, *Notices Amer. Math. Soc.* **65** (2) (2018), 144-147.
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Artículos mencionados en el texto:

Edray Goins 'Three Questions

Edray Herber Goins published the article 'Three Questions: The Journey of One Black Mathematician, *Notices Amer. Math. Soc.* **65** (2) (2018), 144-147'. At the time he was on the faculty at Purdue University as a full professor but later in 2018 he resigned for reasons detailed in our biography. We give a version of his 2018 paper, but we have omitted the six pictures included in that article:

Three Questions: The Journey of One Black Mathematician

AMC's *The Walking Dead* features a leader of a group who asks three questions whenever he meets strangers who might possibly join his group. Well, I am the president of the National Association of Mathematicians (NAM), a professional organization that seeks to increase the public awareness of issues of importance to underrepresented minorities in the mathematical sciences, and I would like to modify these questions and ask you the following:

How many African American mathematicians have you graduated?

How many African American mathematicians have you hired?

Why?

Permit me to take you on a journey of personal growth as I have asked these questions of myself while navigating the mathematical professoriate.

My Undergraduate Days in Pasadena

She's the terror of Colorado Boulevard | It's The Little Old Lady from Pasadena!
"The Little Old Lady from Pasadena," The Beach Boys

When I was an undergraduate at the California Institute of Technology, I spent a lot of time wondering about those who looked like me - about African Americans in mathematics, to be precise. I graduated from a predominantly African American high school in Los Angeles in 1990. Yet fifteen miles away in Pasadena there were only 14 Black students in Caltech's freshman class of nearly 180 students. In fact there were fewer than 50 Black students out of nearly 2,000 undergraduate and graduate students. And there were only 2 Black faculty out of nearly 300.

I wanted to know: Why were these numbers so low?

As an African American double-majoring in mathematics and physics, I wanted to know whether the numbers were just as low at other universities. In 1992, during my sophomore year, I found out that Stanford University would host the annual National Conference of Black Physics Students (NCBPS). I decided to attend the conference as the sole representative from Caltech, and I was glad that I did. I learned that I wasn't alone as an African American in mathematics and physics. I made friends at that meeting who remain friends to this day. And I met three African Americans at that conference who would become lifelong mentors: Ronald E Mickens of Clark Atlanta University, Bill Massey of AT&T Bell Labs, and Sylvester James Gates of the University of Maryland.

But the meeting left me a little confused. There were many capable mathematicians and physicists at this conference - undergraduate students, graduate students, postdoctoral fellows, and faculty. So why were the numbers so small at Caltech?

I asked several faculty about what Caltech had done to recruit faculty over the years. My advisor in physics, Steve Frautschi, told me about the time they tried to hire a young African American physicist from MIT who was a postdoc at Caltech. Unfortunately things didn't work out for several reasons, although he was a pretty successful physicist at the University of Maryland. Frautschi thought it would be great if I met the guy one day. His name was Sylvester James Gates.

So the same person who founded the National Conference of Black Physics Students was almost a Caltech professor? Now I really wanted to learn more.

My Brief Stint as a Historian

The great force of history comes from the fact that we carry it within us, are unconsciously controlled by it in many ways, and history is literally present in all that we do.
James Baldwin

I decided to spend my senior year at Caltech studying the history of African Americans at Caltech. I wanted to know about the first African American undergraduate and graduate students. I wanted to learn more about their experiences, and whether the numbers were always so small. I had some rather surprising revelations.

- i. The first African American undergraduate at Caltech was Grant D Venerable; he graduated in 1932 with a Bachelor of Science in Civil Engineering.
- ii. The first African American graduate student at Caltech was James Lu Valle; he graduated in 1940 with a Doctorate in Chemistry. In fact, Lu Valle won a bronze medal in the 1936 Olympics in Berlin - yes, the same Olympics where that other African American, Jesse Owens, won a gold medal. The Graduate Student Union at UCLA is named after him, and Morehouse College recently established a fellowship in his honour using funds from Jim Simons.
- iii. The second African American undergraduate at Caltech was Charles Hosewell McGruder; he graduated in 1965 with a Bachelor of Science in Astronomy. There were no other Black undergraduates after Venerable graduated in 1932 until McGruder enrolled in 1961. As fate would have it, I met McGruder at the National Conference of Black Physics Students in 1998, while I was a graduate student.

I also learned that the number of African American students was not always so small. Long time Caltech employee Lee Browne spent years recruiting students from Los Angeles to attend Caltech. When

affirmative action began in earnest in the early 1970s, Browne successfully recruited dozens of African Americans. In fact, the largest population of Black students was during the mid 1970s! One of those undergraduates was Robert Thornton, who was my mentor through my scholarship with the American Physical Society (APS). Another was Loretta Carroll, a woman I had known while growing up in Los Angeles. Sadly, I didn't know until I conducted this research that either was a Caltech graduate. ... With this knowledge, I finally felt connected to a larger community. The numbers of students and faculty were small at Caltech, but there were many others out there with whom I had a historical connection.

Time on the Farm

*We hailin from East Oakland, California and, um
Sometimes it gets a little hectic out there
But right now, yo, we gonna up you on how we just chill.
" '93 Til Infinity," Souls of Mischief*

The 1992 NCBPS meeting at Stanford convinced me that Stanford was where I should pursue my graduate studies. I was a doctoral student in the mathematics department, although I spent a lot of time in the physics department as well. Not surprisingly, the numbers of African American students and faculty at Stanford were very small. I was the only Black student in the mathematics department, and there were no Black professors.

I received a pleasant surprise in my second year at Stanford. The December 1995 issue of the *Notices* featured a conference for African American mathematicians that had just taken place in Berkeley a few months before. I had mixed feelings: There was a conference for African American Researchers in the Mathematical Sciences (CAARMS)?! How come I didn't know about it until after?!

In the midst of this confusion, I received a phone call one evening. "I'd like to introduce myself," the voice said, "I am Bill Massey. I started CAARMS." Yes, this was the same person I had met some four years earlier at the NCBPS meeting! "You might be curious to know that I got my doctorate in mathematics from Stanford as well." Massey went on to say there was one other African American to get a doctorate in mathematics from Stanford, so as far as I know there are just three of us now. I may have been the only African American student in mathematics at the time, but I would not be the first African American to graduate from Stanford with a doctorate in mathematics. As proof that I did finish with this degree, [a photograph] shows me and some friends as we marched through Stanford's Black Graduation ceremony.

Once again, I realized that I was part of a larger community than what I was seeing in graduate school. Eventually I would attend many CAARMS conferences and make many more lifelong friends. [Another picture] shows several of us at a later CAARMS in 2000 outside the home of Mel Currie.

Indiana Wants Me

*I'm goin' back to Indiana | Back to where my baby's from I'm goin' back to Indiana | Indiana here I come.
"Goin' Back to Indiana," The Jackson 5*

By the time I accepted my first tenure-track position at Purdue University, I had nearly resigned myself to the idea that I would just be one of a handful of African Americans in my mathematics department. Still, part of me realized I had to do something to change this.

So I went out to recruit my own African American graduate students. My first graduate student was Kevin Muriithi Mugo, who graduated from Purdue in 2014. We met while working together during an NSF-funded REU at Miami University called the Summer Undergraduate Mathematical Sciences Research Institute. I was so impressed by the success Miami University had in recruiting women and underrepresented minorities for their REU that recently I started my own REU titled the Purdue Research in Mathematics Experience (PRiME).

But I began to wonder much as I had done while an undergraduate: What about the history of African Americans at Purdue? I wanted to know about the first African American graduate students in the mathematics department.

As I tried to ask around Purdue, I realized no one kept records of every African American to come through the math department. Fortunately, one of the first graduates is my mentor as president of NAM, and he had been collecting this information on his own for years! We both discovered that there have been seven African Americans to graduate with a doctorate in mathematics from Purdue:

- i. Melvin L Heard, who is now associate professor of mathematics and assistant dean in the College of Liberal Arts at the University of Illinois at Chicago (UIC), finished in 1967 under Robert Arnold Gambill and Merritt S Webster.

- ii. Benjamin Joseph Martin, who is now head pastor at St Rest Baptist Church, finished in 1969 under Thomas Wilson Mullikin.
- iii. Johnny L Houston, who is now emeritus professor of mathematics at Elizabeth City State University (ECSU), finished in 1974 under Eugene V Schenkman.
- iv. Kathy Marie Lewis, who is now associate professor of mathematics at Morehead State University, finished in 1999 under Carl Cowen.
- v. Sean Colbert-Kelley, who is now a scientist at the National Institute of Standards and Technology (NIST), finished in 2012 under Daniel Phillips.
- vi. Kevin Muriithi Mugo, finished in 2014 under me.
- vii. Reginald L McGee, who is now a postdoctoral fellow at the Mathematical Biosciences Institute (MBI), finished in 2015 under Gregory T Buzzard.

Semper Adquirens

Now that I am a full professor at Purdue University, I spend a lot of time pondering the three questions that began this article. *How many African American mathematicians have you graduated?* My department has graduated seven with doctorates in mathematics, while I have graduated just one. *How many African American mathematicians have you hired?* Sadly none have been hired as tenure-track during my years at Purdue, although we did hire one as a postdoctoral fellow for three years. *Why?* I don't know exactly. I have tried to recruit many, many African American students and faculty to Purdue in the thirteen years I've been on the faculty. I'm still looking for answers.

I'm still amazed that, after all of these years, I look to Jim Gates, Bill Massey, and Ronald E Mickens for advice and inspiration. As president of NAM, I was honoured to have Jim Gates serve on our annual NAM Panel Discussion at the 2017 Joint Mathematics Meetings in Atlanta. As a director of an NSF-funded REU, I was thrilled to have my own undergraduates meet Bill Massey at the 23rd annual CAARMS at the University of Michigan in 2017. And as a lover of mathematics, I am looking forward to watching Ronald Mickens speak at the 2018 Joint Mathematics Meetings in San Diego as NAM's Claytor-Woodard Lecturer.

And yes, I'm still asking them the Three Questions.

About the Author

Edray Goins has been working on properties of Selmer groups for elliptic curves using class groups of number fields, as well as properties of Dessins d'Enfants. He runs an REU that focuses on understanding properties of Belyi maps, and he maintains his own blog about Dessins d'Enfants.

Edray Goins on being an African-American mathematician

We reproduce below a version of the article *For a Black Mathematician, What It's Like to Be the 'Only One'* which was published in *The New York Times* on 18 February 2019.

For a Black Mathematician, What It's Like to Be the 'Only One'

Fewer than 1 per cent of doctorates in mathematics are awarded to African-Americans. Edray Goins, who earned one of them, found the upper reaches of the mathematical world a challenging place.

By Amy Harmon
BALTIMORE

It was not an overt incident of racism that prompted Edray Goins, an African-American mathematician in

the prime of his career, to abandon his tenured position on the faculty of a major research university last year.

The hostilities he perceived were subtle, the signs of disrespect unspoken.

There was the time he was brushed aside by the leaders of his field when he approached with a math question at a conference. There were the reports from students in his department at Purdue University that a white professor had warned them not to work with him.

One of only perhaps a dozen black mathematicians among nearly 2,000 tenured faculty members in the nation's top 50 math departments, Dr Goins frequently asked himself whether he was right to factor race into the challenges he faced.

That question from a senior colleague on his area of expertise, directed to someone else? His department's disinclination to nominate him to the committee that controls hiring? The presumption, by a famous visiting scholar, that he was another professor's student?

What about the chorus of chortling that erupted at a lunch with white and Asian colleagues when, in response to his suggestion that they invite underrepresented minorities as seminar speakers, one feigned confusion and asked if Australians qualified.

"I can give you instance after instance," Dr Goins, 46, said as he navigated the annual meeting of the nation's mathematicians in Baltimore last month. "But even for myself I question, 'Did it really happen that way, or am I blowing it out of proportion? Is this really about race?'"

The 'leaky pipeline'

Black Americans receive about 7 per cent of the doctoral degrees awarded each year across all disciplines, but they have received just 1 per cent of those granted over the last decade in mathematics. Like many who see in that disparity a large pool of untapped talent, Dr Goins has long been preoccupied with fixing what is known as the "leaky pipeline."

Redress the racial disparities that exist at every level of math education, the logic goes, and racial diversity among those who grapple with math's biggest problems will follow.

To that end, Dr Goins delivers guest lectures to underrepresented middle and high school math students, organizes summer research programs for underrepresented math undergraduates, mentors underrepresented math graduate students, and heads an advocacy group that was formed in 1969 after the American Mathematical Society, the professional association for research mathematicians, rejected a proposal to address the dearth of black and Hispanic members.

Dr Goins's own journey through the pipeline was propelled by a magnet program that offered Advanced Placement calculus for the first time at his majority-black south Los Angeles high school. In 1990, having aced the A.P. calculus BC exam, he became the first student from the school ever to gain admission to the prestigious California Institute of Technology, just 20 miles away.

The 10 black students in his incoming class were the largest group Caltech had ever enrolled, he learned when he wrote a paper on the little-known history of being black at Caltech for a summer research project. Only three of the others graduated with him four years later.

Most of his classmates, Dr Goins quickly realized, had arrived with math training that went far beyond his own. In his freshman year, he sometimes called his high school calculus teacher for help with the homework. In his sophomore year, he watched from his dormitory television as the 1992 Los Angeles riots erupted a few blocks from his mother's home. But he also came to excel in applied math, which traffics in real-world problems, and, later, to immerse himself in "pure math," which seeks to elucidate the questions intrinsic to mathematics itself.

Dr Goins won two math prizes at Caltech, and in 1999 he received a Ph.D. from Stanford's math department - one of three African-Americans that have ever done so, according to an informal count by William Massey, a Princeton professor who received the second. In 2004, after holding a visiting scholar position at the Institute for Advanced Study in Princeton and another at Harvard, Dr Goins joined the faculty of Purdue in West Lafayette, Ind.

"You are such an inspiration to us all," Talitha Washington, a black mathematician who is now a tenured professor at Howard University, wrote on his Facebook page when he received tenure in the spring of 2010.

Yet having emerged at the far end of the pipeline, Dr Goins found himself unwilling to stay. Last fall, in a move almost unheard-of in the academic ecosystem, he traded his full professor post at Purdue, where federal resources are directed at tackling science's unsolved problems and training a new generation of Ph.D.'s, for a full professorship at Pomona, a liberal arts college outside Los Angeles that prioritizes undergraduate teaching.

"Edray," he recalled one colleague telling him, "you are throwing your career away."

"Who do they make eye contact with?"

In an essay that has been widely shared over the last year, Dr Goins sought to explain himself. He extolled the virtues of teaching undergraduates and vowed to continue his research. But he also gave voice to a lament about the loneliness of being black in a profession marked by extraordinary racial imbalance.

"I am an African-American male," Dr Goins wrote in a blog published by the American Mathematical Society. "I have been the only one in most of the universities I've been to - the only student or faculty in the mathematics department."

"To say that I feel isolated," he continued, "is an understatement."

Experiences similar to Dr Goins's are reflected in recent studies by academic institutions on attrition among underrepresented minorities and women across many disciplines. Interviews with departing faculty of color indicated that "improving the climate" would be key to retaining them, according to a 2016 University of Michigan report. Officials at Columbia, which has spent over \$85 million since 2005 to increase faculty diversity, with disappointing results, suggested last fall that progress would hinge partly on majority-group faculty members adjusting their personal behavior.

"In most cases, faculty are not consciously or purposely trying to make colleagues feel unwelcome or excluded," said Maya Tolstoy, dean of Columbia's arts and science faculty. "But it happens."

And at the recent math meeting, where Dr Goins delivered a keynote address titled "A Dream Deferred: 50 Years of Blacks in Mathematics," his presence kindled conversations about racial slights in the mathematical world. The presumption of competence and authority that seems to be automatically accorded other mathematicians, for instance, is often not applied to them, several black mathematicians said.

"Who do they make eye contact with? Not you," said Nathaniel Whitaker, an African-American who heads the department of mathematics and statistics at the University of Massachusetts at Amherst.

Michael Young, a mathematician at Iowa State University, said he almost gave up on graph theory a few years ago after an encounter with some of the leaders of the field at a math institute at the University of California, Los Angeles.

"A couple of them were at a board writing something," he recalled. "I went over and asked, 'What are you guys working on?'"

"We're too far in to catch you up," he said he was told.

The ethos characterized as meritocracy, some said, is often wielded as a seemingly unassailable excuse for screening out promising minority job candidates who lack a name-brand alma mater or an illustrious mentor. Hiring committees that reflect the mostly white and Asian makeup of most math departments say they are compelled to "choose the 'best,'" said Ryan Hynd, a black mathematician at the University of Pennsylvania, "even though there's no guideline about what 'best' is."

And Ken Ono, a prominent mathematician in Dr Goins's field, number theory, and a vice president of the mathematical society, said that a part of Dr Goins was always likely to be wondering, "'Do they see me as the token African-American, or do they see me as a number theorist?'"

"And honestly, to tell the truth, I think that answer would vary from individual to individual," Dr Ono said.

Most tenured math faculty members at research institutions do not leave, regardless of their race. "I've done well and am really enjoying myself," wrote Chelsea Walton, a black mathematician at the University of Illinois, in a comment on Dr Goins's blog post.

But because role models of the same race are seen as critical to luring talented students from underrepresented minorities into a Ph.D. program, it is a blow to lose even one, Dr Ono said. For the representation of African-Americans in math departments to reach parity with their 13-percent share of the country's adult population, their ranks would have to increase more than tenfold. (The number of women, also notoriously low among math faculty, would need to triple.) "It's a loss to our mathematical community that Edray may never advise graduate students again," said Dr Ono, who is Japanese-American.

An ambitious gambit

Dr Goins's isolation, he himself was the first to note, was also forged by an early career failure. Near the

end of his graduate studies at Stanford, he set out to prove a conjecture using techniques suggested by the solution to a 350-year-old problem, Fermat's last theorem, which had rocked the mathematical world a few years earlier.

It was an ambitious undertaking whose success would probably have snagged him job offers from the most elite math departments in the country. But the conjecture was grounded in a highly technical area populated by the field's top talent. And despite guidance from Richard Taylor, a white mathematician then at Harvard who had assisted in solving Fermat's theorem, Dr Goins was unable to publish the paper he produced four years later.

Several mathematicians familiar with Dr Goins's efforts said they did not see racial discrimination as playing a role. It is not all that unusual, they said, for such an ambitious undertaking to end in an unsatisfying result. But it also can require deep reserves of self-confidence and a professional network to bounce back.

Dr Goins's colleagues at Purdue said his receipt of tenure and subsequent promotion to full professor signaled the university's willingness to overlook a sparse research portfolio in light of his extraordinary work with undergraduates, as well as the summer programs he organized for minority students.

"While these areas are not necessarily 'traditional' markers for excellence at major research universities, they were valued," Greg Buzzard, the head of Purdue's math department, who is white, said in a statement.

But Dr Goins said he was looking for something else.

"I just never really felt respected," he said.

At the math meeting last month, Dr Goins's essay was not immune from criticism.

Some black mathematicians questioned the utility of dwelling on perceived slights, many of which are unconscious or made out of ignorance.

Some who know Dr Goins noted his sensitivity. Insults that others might shrug off, they said, might stick with him.

For Bobby Wilson, a mathematician at the University of Washington, offenses related to race "just start to wash over you." He added: "That doesn't mean it's right or good."

Over dinner one evening, another black mathematician told Dr Goins that he was worried that his blog account of the difficulties he faced might discourage black graduate students who hope to pursue careers in academic research.

Maybe, it was suggested, he should have kept it to himself.

Dr Goins, taking that in, was silent. His reply came only the next day.

"I didn't write it to tell people what should happen," he said. "I wrote it to tell people what could happen."

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