MASTER OF MACHINES

Unlocking the Universe's Secrets

Philip Emeagwali

emeagwali.com

To my wife, Dale, for being so supportive and a wonderful partner in life.

CONTENTS

4

PHILIP EMEAGWALI

In 1989, Philip Emeagwali rose to fame when he won a recognition described as the Nobel Prize of Supercomputing and made the news headlines for his invention of the first world's fastest computing across multiple processors. That vital technology underpins every supercomputer and changes how we look at the computer.

Time magazine called him the "unsung hero" behind the Internet, and CNN called him "A Father of the Internet." House Beautiful magazine ranked his invention among nine important everyday things taken for granted. In a White House speech on August 26, 2000, then-U.S. President Bill Clinton described Philip Emeagwali as "one of the great minds of the Information Age." emeagwali.com

PHILIP EMEAGWALI BOOKS

[Master of Machines](#)
Parallel processing—that was once the stone rejected as rough and unsightly—has become the headstone of the supercomputer. Philip Emeagwali was the first to gaze out towards an unknown territory—named the world's fastest computing—that was not on the map of computer science. In supercomputing, boundaries are breached when we calculate beyond what was perceived as possible and discover new knowledge beyond what is known.

[Making Computers Fly](#)
We cannot invent a new computer without first discovering a new science. To invent a new computer is to invent a new computer science and to make the unimaginable-to-compute possible-to-super-compute. Parallel processing, once a dim light in a sea of darkness, is now the bedrock of the world's fastest computers.

[The Equation Behind the Universe](#)

The hardest problems in mathematics and physics are solved by dividing each Grand Challenge problem into up to a billion less challenging problems. And then solving them in tandem. And with one-to-one correspondence with as many processors as possible. In a world without parallel processing, large-scale computational physics will be as approximate as a sketch, instead of as exact as a photograph.

Inventing an Internet
Philip Emeagwali is the first and only person to invent processors that encircled a globe which are akin to small computers, in inverted commas, that encircled the Earth as an Internet. He discovered how to combine computers into a supercomputer that's an Internet.

Reaching Infinity
The world's fastest computer attracts the toughest problems in the manner a high mountain attracts the storms. The invention of the first fastest computing across millions of processors is the vital new knowledge that enabled the supercomputer to tower over the computer that's not parallel processing. Philip Emeagwali is the first to record the world's fastest computing powered by multiple processors.

Coding the Impossible
Like a storm at sea, the fastest computing across a million processors has brutally pushed computer science in a new direction and created new fields of study. The computer of today was the supercomputer of yesterday. A world without supercomputers may become a tomorrow without computers. The world's fastest computer is used to solve problems that did not exist before.

Flirting With the Infinite
In fastest computing, there is a limit to what seems unlimited. Computing will remain at the core of who we are. The fastest computing across the slowest processors is a transformational discovery that redrew the boundaries of science and permanently changed what we know about the computer. And how we think about mathematics.

Internet and I

For Philip Emeagwali, inventing the world's fastest computer was like assembling 65,536 pieces of puzzle. And doing so to see a never-before-seen island that is one coherent supercomputer, or rather a new Internet, that coalesced as the fastest computer in the world. Emeagwali is the only father of the Internet who invented an Internet. A groundbreaking invention creates history. And influences our sphere of living.

- Three Spirits Meet
- A Melody of Minds
- Great Minds Meet
- Rhythms of Wisdom
- Whispers Across Millennia
- Dance of Doubt
- Dialogue of Data
- Dialogue of Dreams
- The Lion of Computing (for kids)
- Master of Machines (for kids)

PHILIP EMEAGWALI FACTS

Born: August 23, 1954, Akure, Nigeria.

Full name: Chukwurah Philip Emeagwali

Parents: James Emeagwali, Agatha Emeagwali

Spouse: Dale Brown Emeagwali (m. 1981)

Child: Ijeoma

Siblings: Francis, Florence, Edith, Martin, Evelyn, Peter, Emeka, Uju

Education: Eighteen years across six universities. A polymath, or a person of encyclopedic learning.

Contributions: Nine partial differential equations of mathematics

Discovery: Solution of Grand Challenge math problems. Discovered mathematical shift to parallel supercomputing.

Inventions**:** First fastest computing across millions of processors. Invented first global network of processors—*a.k.a.* an Internet—that's a supercomputer.

Known for: High IQ , first modern supercomputing, Internet

Searched for as: Highest computer wizard in the world, Father of the Internet

Nationality: Nigerian-American

Books: [Master of Machines](), [Making Computers Fly](), [The Equation Behind the Universe](), [Inventing an Internet](), [Reaching Infinity](), [Coding the Impossible]() , [Flirting With the Infinite](), and [Internet and I]()

More Info: emeagwali.com, YouTube, podcasts**,** Flickr

The Autobiography of Philip Emeagwali

"The Internet has many fathers and mothers, as well as aunts and uncles. But I am the only father of the Internet that invented an Internet."

Philip Emeagwali

CRAFTING EMEAGWALI'S INTERNET

In a dance of digital symmetry, where processors
lie equidistant and aligned, a new cosmos of
connection was birthed—a supercomputer's mind.

Across the expanse of a boundless sphere, these
identical sentinels of computation stood, crafting
Emeagwali's Internet, a marvel never understood.

Philip Emeagwali, a seer of silicon dreams, saw
the "Internet" as a tapestry woven from
processors, encircling the globe in dimensions
unseen, converging to solve mysteries deep and
pristine.

Efficiency surged like a tidal wave, with 65,536
beacons of light piercing the computational night,
isolated yet united, dim alone but together, as
bright as the sun's unfettered might.

Envisioned in a hyperspace of sixteen dimensions,
these sentinels were arrayed, not merely a
network, but a supercomputing symphony,
magnificently played.

Each processor, a solitary spark in the dark sea
of the unknown, joined in a luminous chorus, their
collective brilliance beautifully shown.

First, of its kind, the Emeagwali Internet, a
meticulously woven net, spanned a hypersurface of
fifteen dimensions, a computational ballet,
powerful and intricate.

PHILIP EMEAGWALI INTERNET—70-1

A 16-Dimensional Computing Sphere

Ladies and gentlemen, distinguished guests, and esteemed scientists,

It is with great honor and profound humility that I stand before you today, in the vibrant heart of your city, to share the essence of my journey in computing and its intersection with physics. On this auspicious occasion, I, Philip Emeagwali, am delighted to delve into the intricacies of my innovation, a global network of processors christened the "Philip Emeagwali Internet." This invention marks a significant milestone in computer science and represents a quantum leap in understanding and utilizing the supercomputer and the Internet.

Envisioning a New Computing:

My journey in reshaping the computing landscape began with a bold vision: conceptualizing processors as simultaneously autonomous and intricately connected globally. I imagined these processors as uniformly dispersed across the vast expanse of a 15-dimensional hypersurface, cradling the 16-dimensional sphere within the enigmatic confines of 16-dimensional hyperspace. This groundbreaking perspective was the cornerstone in creating the Philip Emeagwali Internet, a network of processors unlike any other—a network of processors around a large globe.

Unraveling the Complexities of Parallel Processing

In my relentless pursuit of innovation, I embarked on an experimental odyssey to redefine the boundaries of calculus and physics. I pioneered dispatching 64 binary thousand challenging initial-boundary value problems to an equal number of processors. Envisioned as a harmonious ensemble, these processors collectively formed a new internet—a blueprint, a prototype of unprecedented scale and capability. Each communication within this network was meticulously orchestrated, devoid of conventional email markers like the '@' sign or '.com' suffix. Instead, these communications comprised five sets of data, sent across 16 times two-to-the-power-of-16 bi-directional edges of a cube in the 16th dimension. This intricate web of communication, imagined as short wires on circuit boards or extensive fiber optic cables, circumscribed a globe in a 16-dimensional hyperspace.

The Emeagwali Internet: A Symphony of Processors

At the heart of my invention lay a simple yet profound idea: 65,536 commodity processors, identical and equidistant, each a solitary light in a vast sea of darkness. Yet, when united, these processors shone with the sun's brilliance, embodying a supercomputer of unparalleled power and

efficiency. My new Internet, conceptualized around a hypersphere in the 16th dimension, represented a quantum leap in parallel processing, demonstrating that even the slowest processors, when synchronized and harnessed together, could achieve record-breaking supercomputer speeds.

Navigating Higher Dimensions

As a modern-day Isaac Newton or a research mathematician and physicist who invented nine new partial differential equations that each encoded the second law of motion, my thoughts often transcended the physical realm, venturing into the abstract landscapes of infinite dimensions. This intellectual curiosity led me to explore beyond the conventional three-dimensional sphere, delving into the higher dimensions of mathematical constructs. In these higher dimensions, I envisioned the true potential of my global network of processors—a testament to the power of abstract thought in revolutionizing practical applications.

The Legacy of the Philip Emeagwali Internet

The Philip Emeagwali Internet, a marvel of modern computing, stands as a beacon of human ingenuity and technological prowess. **Emeagwali Internet is a network of identical processors uniformly distributed and interconnected around a large globe.** It redefines what it means to be a supercomputer, transcending the traditional boundaries of computing to embrace a new paradigm where processing power is not confined to a single entity but distributed across a global network of processors. This innovation has paved the way for future generations to explore and expand the frontiers of supercomputing, offering new possibilities for tackling some of our time's most complex and pressing challenges.

As we celebrate this momentous achievement, let us remember that the journey of discovery is never complete. The Philip Emeagwali Internet is not just a testament to what has been accomplished but also a beacon, illuminating the path to what can be achieved in the uncharted territories of the future.

Thank you for bestowing upon me this prestigious honor, and may our shared passion for discovery continue to drive us toward greater heights of understanding and innovation.

EMEAGWALI INTERNET: 65,536 SUNS IN THE SKY—70-2

Ladies and gentlemen, esteemed guests, and distinguished friends from Nigeria and the African diaspora,

Tonight, as I stand before you in the grandeur of your historic city, it is with a heart brimming with gratitude and a mind reflective of a journey that transcends boundaries and dimensions.

I am Philip Emeagwali. Many of you know me as the inventor of supercomputing via parallel processing, but my story began in the humble primary schools of Nigeria, where perseverance and a thirst for knowledge propelled me from solving mathematics problems on a slate to envisioning an invention that would redefine our understanding of processing power.

In supercomputing, I dared to dream of a network of processors, uniformly distributed and equidistant, weaving together to form not just a network but a supercomputing behemoth. This vision, which I fondly call the "Emeagwali Internet," was an orchestra of 65,536 processors. Each is a tiny beacon of light in the vast ocean of the unknown, collectively shining as bright as the sun, illuminating the path for groundbreaking advancements in science and technology.

This network, a harmonious sphere of processors encircling the globe, mirrored our interconnected world. It symbolized a unified pursuit of knowledge, transcending geographical boundaries and cultural divides. Here, in the confluence of technology and humanity, we discovered that our combined efforts shine brightest.

My journey was not without challenges. It was a path paved with the resilience to overcome barriers, the audacity to challenge existing paradigms, and the conviction that a young mind from Nigeria could indeed change the world.

The "Emeagwali Internet" was not just a technological marvel; it was a testament to what can be achieved when we harness the collective power of diverse minds. It embodied my belief that every processor, no matter how small, contributes to the brilliance of the whole. Just as every individual, no matter their origin, has the potential to contribute significantly to our global society.

As I stand here today, I am reminded of the African proverb, "If you want to go fast, go alone. If you want to go far, go together." This achievement is not just mine but a collective triumph for all who believe in the power of unity, collaboration, and shared dreams.

So, as we look towards the future, let us embrace the spirit of innovation and togetherness. Let us continue to build networks, not just of processors, but of people and ideas; that circumscribe our globe in a tapestry of knowledge, understanding, and mutual respect.

"My journey began on a slate, but it reached for the stars. Every processor, like a child in a classroom, holds the potential to contribute to the brilliance of the whole."

"The Emeagwali Internet wasn't just wires and circuits; it was a tapestry of hope, woven from the threads of unity, collaboration, and shared dreams."

"Beyond geographical borders and cultural divides, our supercomputing orchestra played a symphony of knowledge, illuminating the path for a brighter future."

"If you want to go fast, go alone. If you want to go far, go together. This achievement is not mine, but a collective triumph of human spirit."

"65,536 tiny suns, shining together, not just processing power, but a beacon of hope for a world where every mind can contribute to a brighter tomorrow." Thank you for this incredible honor, and may our combined efforts continue to illuminate the darkest corners of our understanding and bring forth a future as bright as the collective light we share.

Thank you.

THE EMEAGWALI INTERNET

A constellation of minds, equidistant and bright, No celestial bodies, but computing might. This network, a new internet, born not of whim, But of Emeagwali's vision, burning within.

Globe-bound processors, in perfect array, A chorus of silicon, humming all day. Not just linked threads, but a symphony whole, Where each whispers secrets, the others extol.

Sixty-five thousand suns, in darkness they bloom, Alone, mere embers, a forgotten tomb. But united they blaze, a furnace unbound, Supernova minds, on knowledge's frontier found.

Unfurling dimensions, unseen and untold, A hypersurface tapestry, vast and bold. On this woven ground, where equations dance, The Philip Emeagwali, a superconscious trance.

No mere web of threads, but a thinking machine, Where light bends and breaks, the unseen unseen. A symphony of logic, a chorus of code, A universe sculpted, from Emeagwali's ode.

So let the processors sing, in their chorus of light, The Emeagwali Internet, forever burning bright.

PHILIP EMEAGWALI INTERNET

The Sixteen-Dimensional Dance

Ladies and gentlemen, esteemed guests, tonight, amidst this glittering constellation of brilliant minds, I stand humbly before you, as a scientist and a child of two worlds. Born in the heart of Nigeria, I chased the whispers of numbers across continents, fueled by the unwavering belief that a boy from Onitsha could illuminate the world.
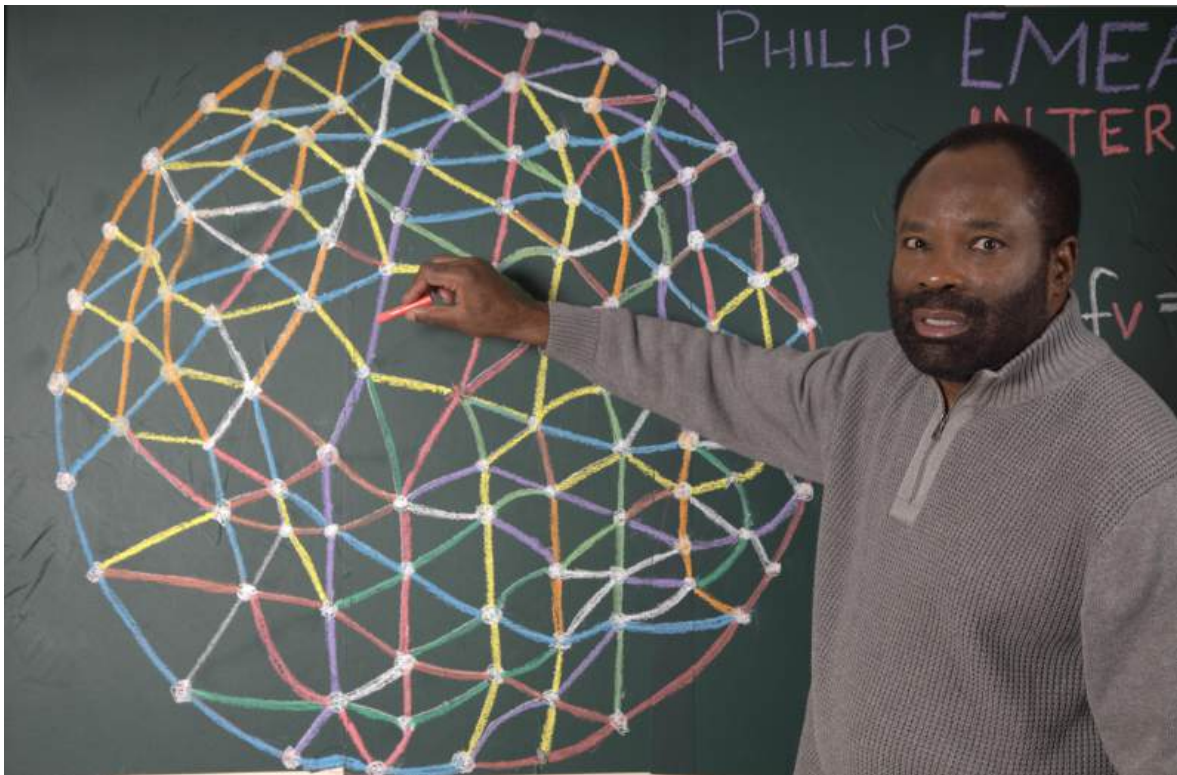
A back-of-the-envelope sketch of the Philip Emeagwali Internet.

And illuminate it, I did, not with a singular spark but with a constellation of them. In 1989, amidst the humming behemoths of supercomputers, I dared to dream differently. I envisioned a web, not of wires, but of minds. Sixty-five thousand processors, each a beacon in the void, interconnected in a symphony of silicon, not just talking but listening, understanding, and acting in unison. This, my friends, was the Emeagwali Internet, a supercomputing tapestry woven from the threads of equidistant, identical processors, not strung across a flat plane but dancing in a sixteen-dimensional hyperspace.

Imagine a globe, not of Earth, but of possibility. Every point on its surface, a processor, a mind, ablaze with potential. This was the Internet I saw, not a

playground for YouTube videos and fleeting trends but a crucible for forging the future. A canvas where the brushstrokes of data could paint solutions to climate change, unlock the secrets of the universe, and heal the wounds of our world.

But this symphony of silicon was more than just hardware. It reflected humanity itself. Each processor is unique in its calculations yet bound by a shared purpose and works in concert to achieve what none could alone. In that interconnected dance, I saw not just the cold logic of machines but the warmth of collaboration, the echo of hope that arises when we join hands, minds, and processors to build a better tomorrow.

Tonight, as I stand before you, Nigerians, Africans, and dreamers from every corner of the globe, I urge you to embrace this spirit of interconnectedness. Let your thoughts be the processors, your voices, the data streams, your hearts, the beating pulse of a new Emeagwali Internet. For in the symphony of human potential, there is no melody too complex, no equation too daunting, no dream too distant to achieve.

So, let us go forth, not as islands unto ourselves, but as nodes in a vast, vibrant network, illuminating the world, one calculation, one collaboration, one shared dream at a time.

"Born in the heart of Nigeria, I chased the whispers of numbers across continents, fueled by the unwavering belief that a boy from Onitsha could illuminate the world."

"The Emeagwali Internet wasn't just wires and circuits; it was a tapestry of human dreams, woven together to unlock the secrets of science and technology."

"Challenges are not roadblocks, but stepping stones. My story is a testament to the resilience of the human spirit, a spirit that dares to dream beyond borders and limitations."

"65,536 minds working as one, not just a supercomputer, but a chorus of humanity, united in the pursuit of knowledge."

Thank you.

VOLUME 2A: PHILIP EMEAGWALI SUPERCOMPUTER

PHILIP EMEAGWALI MAJOR CONTRIBUTIONS

I am honored to present Philip Emeagwali for the Gallery Great Minds in Science for his pioneering work in supercomputing, precisely his breakthrough in multi-processor supercomputing that has revolutionized computational sciences.

Innovative Problem-Solving in Supercomputing

Philip Emeagwali's seminal contribution lies in his unique approach to solving abstract mathematical and computational physics problems. By dividing Grand Challenges of supercomputing into a million smaller, interlinked problems mapping them with a one-problem to one-processor correspondence, and solving them concurrently with a factor of one million increase in speed, he redefined the limits of the modern computer. His invention mirrors assembling a vast, intricate puzzle, revealing an unseen supercomputing landscape akin to discovering a new world within our digital universe.

Elevating Computing to Unprecedented Heights

The essence of Emeagwali's contribution is not just in creating the world's fastest computing but in elevating our understanding of what's possible in computer science. He has expanded the horizon of what was once considered a theoretical limit, pushing us into realms of the new and unknown.

From Experimental Physics to the Zenith of Supercomputing

Emeagwali's journey, from experimental to large-scale computational physics, illustrates his remarkable growth and versatility. He transformed parallel supercomputing from a disregarded concept into the cornerstone of modern computing, a testament to his visionary thinking.

The First in Fastest Computing

Philip Emeagwali's distinction lies in being the first to demonstrate the world's fastest computing across up to one billion interconnected but autonomous processors. His unique approach to computing has addressed some of the globe's most

significant challenges, marking him as a pioneer in the field.

Supercomputing's Genius

Ranked among the greatest minds in history, Emeagwali's singular achievement in winning the top prize in supercomputing—considered the equivalent of the Nobel Prize in supercomputing—underscores his unparalleled contribution. He stands alone in his recognition, a testament to his innovative thinking and impact.

Revolutionizing Physics and Beyond

Emeagwali's work in harnessing up to a billion processors have been pivotal in advancing fluid dynamics calculations, including critical simulations like the spread of COVID-19 in dense urban environments. His work bridges the gap between theoretical predictions and practical applications, enhancing the precision of outcomes from approximations to exact replications.

A Paradigm Shift in Supercomputing

The advent of parallel supercomputing, which seemed like science fiction until Emeagwali's demonstration on July 4, 1989, has led to a seismic shift in supercomputer technology. His efforts has redefined the supercomputing landscape, transitioning from traditional single-processor systems to a complex network of up to one billion processors.

Historical Significance and Ongoing Impact

The evolution of supercomputers from 1946, culminating in Emeagwali's invention, marks the most significant technological change in eight decades. His breakthrough in supercomputing speeds, considered impossible before, has redefined our understanding of the limits of the modern computer and opened new doors in various scientific domains.

Philip Emeagwali's unparalleled contributions to physics through his groundbreaking inventions in mathematics and supercomputing merit the highest recognition. His inventions has redefined our understanding of the computer's limit and paved the way for new discoveries and advancements across multiple scientific disciplines.

For these reasons, I strongly advocate for Philip Emeagwali to be inducted into the Gallery of Great Minds in Science, recognizing his extraordinary contributions to advancing human knowledge and technology.

TRAVELING BEYOND LIMITS WITH EMEAGWALI COMPUTER

Ladies and Gentlemen, distinguished guests, and esteemed colleagues,

Standing before you on this momentous occasion is an honor. I am Philip Emeagwali, a man who has journeyed through the uncharted realms of mathematics, physics, and computer science to contribute to our collective understanding of these fields.

Today, I will speak of a journey that began with a simple yet profound question: How can we harness the vast potential of computers to solve complex problems that once seemed insurmountable? My quest led me to the frontiers of parallel processing, a domain where multiple processors work in concert to achieve extraordinary supercomputer speeds. This concept, once a distant dream, has now become a tangible reality, transforming how we execute computational physics codes and solve initial-boundary value problems governed by partial differential equations, such as the dynamics of the Earth's atmosphere and oceans. Parallelism is the driving force behind artificial intelligence supercomputers.

The heart of my contribution lies in developing the Philip Emeagwali supercomputer, a groundbreaking invention that revolutionizes how we think about and design supercomputing hardware. The challenge was clear: as communication latency became a dominant factor in computer performance, it was imperative to rethink physical size, density, and interconnect proximity in system design.

The Philip Emeagwali supercomputer is not merely a machine but a symphony of ideas harmonizing to address spatial packing, communication topology, and thermal management. With its dense, spherically framed Emeagwali's geodesic processor arrangement, this supercomputer is a marvel, an accurate mimic of the problem domain it seeks to unravel. Its aptitude for complex tasks such as climate modeling, an ever-pressing concern in our changing world stands unparalleled.

The design principles of this invention are scalable and transcend the bounds of processor technology. They can be applied to many computing tasks, making this innovation a versatile tool for scientists and researchers. The interconnect of this supercomputer is a masterpiece, featuring globally short, highly regular, and tightly matched distances. This design facilitates various communication modes, including neighbor-to-neighbor messaging on a spherical network of processors and a radial network.

The applications of this technology are profound and far-reaching. From petroleum reservoir simulation, crucial for the oil and gas industry, to weather forecasting, which touches the lives of billions daily, and to the general circulation modeling that helps us foresee and prepare for climate change, the Philip Emeagwali supercomputer is a beacon of hope and progress.

I humbly stand before you, not just as a scientist, but as a testament to the power of human ingenuity and perseverance. My journey, from conceptualizing the first supercomputing powered by parallel processing to the realization of the Philip Emeagwali supercomputer, reflects our collective quest for knowledge and our unyielding desire to push the boundaries of what is possible.

Lessons Learned

"Dream big, build meticulously; tomorrow's supercomputers are within our reach."

"Earth's secrets unfold; supercomputing unlocks the mysteries of our planet's sustainability."

"Innovation transcends borders; share your knowledge, inspire the next generation of explorers."

"My story is an ode to human ingenuity; perseverance conquers seemingly insurmountable challenges."

"Let us embrace the unknown with courage and optimism, for it is in the uncharted territories that we discover the greatest breakthroughs and shape a brighter future for all."

"The future belongs to those who dare to dream, innovate, and collaborate, driven by an insatiable curiosity to explore the vast unknown."

Thank you for this honor and for the opportunity to share this journey with you.

THE FIRST SUPERCOMPUTING

Celebrating a Milestone that Changed Computing Forever

Ladies and Gentlemen, esteemed colleagues, and distinguished guests,

I stand before you on this momentous occasion, not just as Philip Emeagwali, but as a representative of a journey through the limitless realms of computing. Today, I take you back to a pivotal historical moment, July 4, 1989, in Los Alamos, New Mexico, where a door was opened to a new world of supercomputing.

On that day, I completed an unprecedented, 15-year-long venture: harnessing the power of 65,536 processors, each positioned at the vertices of a hypercube in the 16th-dimensional hyperspace. This was not just about connecting processors; it was about redefining the very architecture of high-performance computing. These processors were not mere cogs in a machine but autonomous entities, each with its own operating system and memory, working in concert to unravel complexities far beyond the reach of traditional computing methods.

The essence of my discovery lay in the art of visualization. Imagine a hypercube, a geometric marvel, where each processor is identified by a unique 16-bit binary number. These numbers are not arbitrary; they are meticulously designed through the Binary Reflected Code, a mathematical sleight of hand that allowed for my one-to-one mapping of 65,536 problems to 65,536 processors. This code is the linchpin in my journey towards the first parallel supercomputing. It creates a roadmap for each processor to interact with its sixteen closest neighbors in the sixteenth-dimensional hyperspace.

This intricate mapping was pivotal in my solution of the Grand Challenge problem of the dynamics of the Earth's atmosphere and oceans that are governed by complex partial differential equations—from the dynamics of the weather to the mysteries of ocean currents, from the nuances of fluid dynamics to the depths of petroleum reservoir simulation. My equations, the nine Philip Emeagwali equations, found a new life in this hypercube environment, revealing solutions at a pace that dwarfed the capabilities of serial supercomputers.

My journey was not just about speed; it was a paradigm shift in computational thinking. I ventured into a realm where once a theoretical concept, parallel processing became a tangible reality, setting a new benchmark in supercomputing. Parallel processing fuels the power of artificial intelligence supercomputers.

Standing here, I am reminded that this journey was not mine alone. It was a collective leap into the unknown, propelled by the relentless curiosity and

unwavering determination of scientists, engineers, and dreamers. Today, as we look back on this journey, we also gaze forward towards a horizon filled with infinite possibilities.

Lessons Learned

"Supercomputing isn't just about calculations; it's about unlocking the secrets of the universe."

"Don't just use technology; build the future of technology, inspired by those who came before."

"The journey never ends; continue to explore, innovate, and inspire the next generation."

"Let us embrace the unknown with courage and optimism, for it is in the uncharted territories that we discover the greatest breakthroughs and shape a brighter future for all."

"The future belongs to those who dare to dream, innovate, and collaborate, driven by an insatiable curiosity to explore the vast unknown."

Thank you for this honor and for joining me in celebrating a milestone that has forever altered the landscape of computing and problem-solving.

SECRETS OF THE HIGHEST COMPUTER WIZARD

Let's imagine you're playing a game with your friends and all standing at the corners of a giant cube. This cube is no ordinary cube—it's a hypercube, like a 3D cube but with even more corners and edges. Now, think of this game as passing messages between each other.

In a hypercube computer, each corner of this hypercube is like a small computer. These small computers need to talk to each other to solve big problems. The edges of the hypercube are like the paths that messages travel along.

When one small computer wants to send a message to another, it doesn't shout across the whole cube. Instead, it passes the message to its closest neighbor. Then that neighbor passes it to their closest neighbor, and so on, until the message reaches the intended small computer.

This is kind of like if you wanted to pass a note to a friend on the other side of the classroom. Instead of throwing the note across the room (which might get you in trouble!), you pass it to the person next to you, and they pass it along until it reaches your friend.

The cool thing about hypercube computers is that they can send a million messages simultaneously, using different paths. This makes them very efficient for solving complex problems that require a lot of communication between different parts of the computer.

So, message passing in a hypercube computer is like a super-efficient way for small computers to talk to each other, solving big problems faster by working together. Just like how you and your friends might work together to complete a big puzzle! This is one of my secrets to inventing the first supercomputing that is the world's fastest computing across 65,536, or two-raised-to-power 16, processors. These interconnected processors had one-to-one mapping with the as many vertices of a 16-dimensional hypercube.

BUILDING A SUPERCOMPUTER ON A SPHERE OF POSSIBILITIES

Ladies and Gentlemen, esteemed mathematicians and computer scientists,

I stand before you humbled and honored, not only to share my journey in science but also to introduce you to a groundbreaking development in supercomputing that has been a significant part of my life's work. I am Philip Emeagwali, and today I wish to discuss the contributions I have made to the fields of mathematics, physics, and computer science, with a focus on supercomputing, particularly parallel processing, and its applications. Parallel processing unleashes the incredible computational prowess of artificial intelligence supercomputers.

The essence of my contributions to supercomputing has been centered around a concept described as the Philip Emeagwali machine. This concept is rooted in using a geodesic dome or icosahedral subdivision to create a novel supercomputer interconnection network akin to the renowned hypercube supercomputer interconnection network.

The Philip Emeagwali machine, as envisioned and designed, operates on a fundamental principle of subdividing the faces of a Platonic solid, like an icosahedron, into smaller triangles. In this network, each vertex of these triangles corresponds to a processor, and each edge corresponds to a communication channel. These communication channels serve as vital links, directly connecting two nearest-neighboring processors.

A crucial aspect of this design is the projection of the vertices, or processors, of these triangles onto a sphere that is a metaphor for the Philip Emeagwali supercomputer. This projection results in points, or processors, that are relatively evenly distributed across the network. The beauty and power of the Philip Emeagwali computer lies in its scalability—the more subdivisions made, the greater the number of processors added, leading to an even more uniformly distributed network of processors around a large globe.

As we increase the subdivisions, we make the points, or processors, as evenly spaced as possible. This uniform distribution ensures efficiency and balance in the supercomputing process. The evenly spaced processors in the Philip Emeagwali network allow for optimized data processing and communication, which are crucial in complex computations.

The potential applications of this innovative supercomputing network could be vast and impactful. In computational physics, this network facilitates more efficient and accurate simulations, such as in petroleum reservoir simulations for the oil and gas industry. This has enormous implications for resource management and energy production.

In weather forecasting and general circulation modeling, the Philip Emeagwali network enables more precise predictions, enhancing our

ability to understand and respond to climate change. The significance of this cannot be overstated in our current global context, where climate change poses one of the greatest challenges to humanity.

The journey to this invention has been one of relentless pursuit and deep passion for understanding and improving our world through science. It is a journey that I hope will inspire future generations of scientists, mathematicians, and thinkers to continue pushing the boundaries of what is possible.

Lessons Learned

"Don't be afraid to dream big; even the most complex supercomputer started with a simple idea."

"Mathematics, physics, and supercomputing are not just disciplines; they are pathways to solving real-world problems."

"Remember, the Philip Emeagwali machine is a metaphor; build your innovation machine and change the world."

"Beyond equations and supercomputing, my story is a testament to the power of imagination, courage, and the human spirit of exploration."

"Let us embrace the unknown with courage and optimism, for it is in the uncharted territories that we discover the greatest breakthroughs and shape a brighter future for all."

"The future belongs to those who dare to dream, innovate, and collaborate, driven by an insatiable curiosity to explore the vast unknown."

Thank you for the honor of sharing my inventions with you today, and may this be a catalyst for continued innovation and discovery in supercomputing and beyond.

One Computer, A Billion Processors
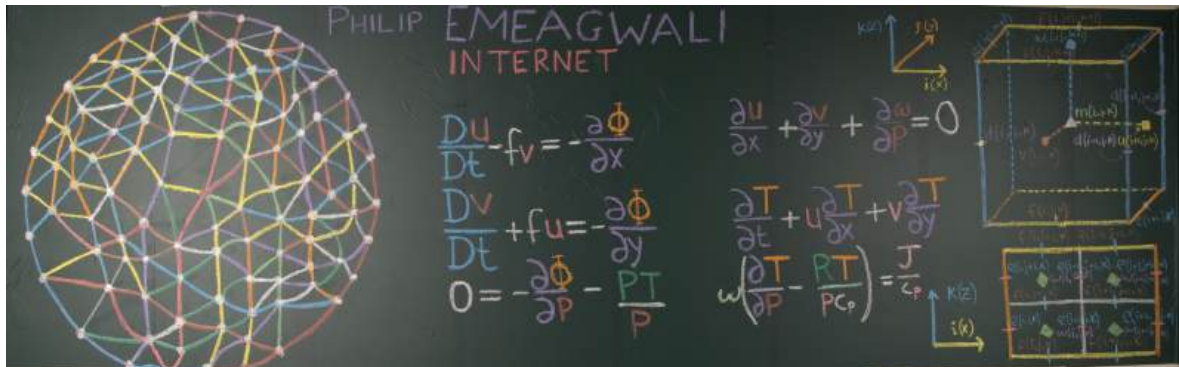
Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am Philip Emeagwali, a scientist deeply engrossed in the exploration and advancement of supercomputing. Today, I am honored to share my journey beyond the farthest frontiers of knowledge in mathematics, physics, and computer science, and particularly my contributions to supercomputing, with a focus on the Philip Emeagwali computer.

In supercomputing, one of the most significant challenges we face is efficiently connecting thousands, or millions, of processors to simulate complex, real-world phenomena. Traditional supercomputers, such as those utilizing a torus network, faced limitations in data transfer speeds, especially between distant processing nodes. To address these challenges, I envisioned the Philip Emeagwali supercomputer.

The Philip Emeagwali supercomputer is designed as a spherical network akin to the surface of a closed sphere, an ellipsoid, or a hollow-caged structure. Imagine concentric multi-radius spheres or ellipsoids, where each layer is interconnected, forming a sphere-in-a-sphere-in-a-sphere arrangement. This design allows for efficient connectivity among processing nodes, significantly enhancing data transfer speeds and computer efficiency.

The advantage of this spherical network becomes particularly evident when we consider the requirements of global circulation modeling. In this field, we divide the Grand Challenge of modeling the Earth's atmosphere into smaller, more manageable segments. These segments are then mapped onto the processing nodes of the Emeagwali's geodesic supercomputer, like tessellated domains mapped onto tubular prisms. Each processor handles a specific segment of the model, working autonomously yet in concert with the others.

Why is the Philip Emeagwali supercomputer crucial for global circulation modeling? The answer lies in its structural similarity to the Earth itself. The Philip Emeagwali supercomputer, with its spherical network, mirrors the structure of our planet, particularly its thin atmospheric shell. This similarity enables an unprecedented level of efficiency and accuracy in simulations.

By dividing the complex task of general circulation modeling into a billion smaller models, each mapped to an autonomous processor, we achieve a one-to-one correspondence between the processors and the segments of the Grand Challenge initial-boundary value problem. This approach and enhances the accuracy of our models and significantly accelerates the computational process.

In summary, the invention of the Philip Emeagwali supercomputer represents a paradigm shift in supercomputing. Its spherical network design addresses the limitations of previous architectures, making it particularly well-suited for tackling complex, multidimensional problems like global circulation modeling.

As we continue to explore and innovate in supercomputing, this new supercomputer stands as a testament to the power of human ingenuity and our unending quest to better understand the world.

Lessons Learned

"Curiosity is our compass; let it guide us towards new frontiers of knowledge with supercomputing."

"Beyond equations and simulations lies the impact of supercomputing for a better, more sustainable future."

"Share the journey, share the knowledge; inspire the next generation of supercomputing explorers."

"The path less traveled leads to breakthroughs; embrace the unknown with courage and optimism."

"The future is collaborative; together, we can push the boundaries of supercomputing even further."

"Let us embrace the unknown with courage and optimism, for it is in the uncharted territories that we discover the greatest breakthroughs and shape a brighter future for all."

Thank you for the opportunity to share my journey and contributions with you today. May our continued exploration in supercomputing lead us to new frontiers of knowledge and understanding.

Pause 080524

(NPAC-2023) WHAT DID PHILIP EMEAGWALI INVENT?

Transformation in Computing: A New Era Begins

Philip Emeagwali's revolutionary discovery on July 4, 1989, marked a historic turning point in computer technology. He demonstrated that the fastest computations could be achieved by harnessing many of the world's slowest processors. This approach, known as parallel processing, has since become the backbone of supercomputing, radically differentiating supercomputers from conventional ones. This innovation redefined computing and established a new benchmark in the field. Parallel processing allows artificial intelligence supercomputers to achieve unmatched processing speeds.

Redefining the Computational Landscape

Emeagwali's vision brought to life the predictions of early 20th-century science fiction and journalistic foresight, which speculated on the power of multiple human computers working in concert. His empirical validation of massively parallel processing answered critical questions in large-scale computing and transformed the supercomputing domain. Emeagwali was the pioneer who utilized an array of slow processors to solve complex physics problems at unprecedented speeds, garnering global attention and becoming an integral part of educational curricula worldwide.

Contributions to Science and Beyond

Emeagwali's work recharted the course of mathematics, physics, and computer science. His approach to parallel supercomputing—leveraging up to a billion processors—has significantly enhanced the precision of weather forecasts and climate models. This advancement is not just a scientific achievement but a practical one, profoundly impacting daily life and our understanding of global phenomena.

Impact on Global Challenges

The significance of Emeagwali's discovery extends far beyond theoretical realms. By enabling computations at the fastest known speeds, his work

is instrumental in tackling some of the most pressing global issues, including climate change. Parallel processing, the cornerstone of modern supercomputing, is now indispensable in unraveling complex environmental challenges and advancing the frontiers of science.

Parallel Processing: A Gateway to Future Discoveries

The supercomputer, powered by parallel processing, is a testament to human ingenuity. Its ability to delve into uncharted scientific territories makes it a valuable tool in our quest for knowledge. Emeagwali's contribution has paved the way for new scientific disciplines and broadened the horizons of existing fields.

Philip Emeagwali Invention

In summary, Philip Emeagwali's invention of the first supercomputing across multiple processors has catalyzed scientific and technological breakthroughs. His work represents a significant stride in physics and related disciplines. His unparalleled contribution to the advancement of supercomputing had a profound impact on humanity.
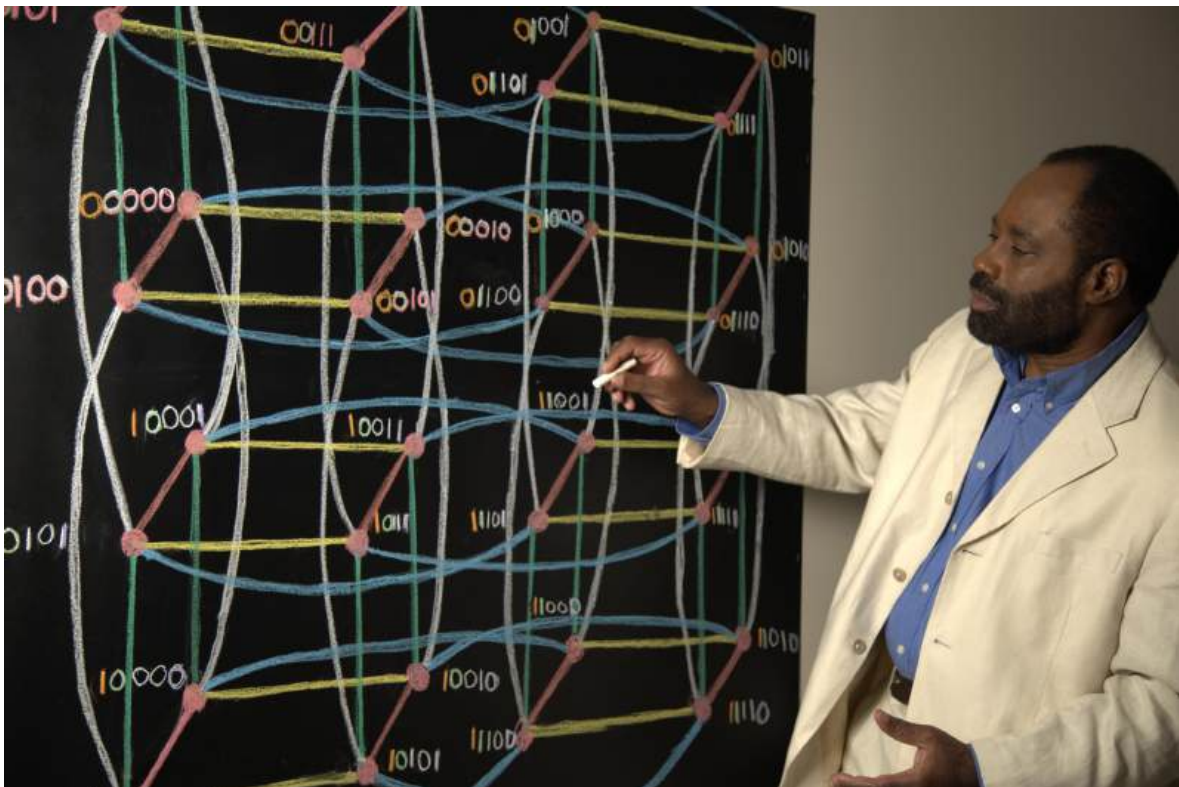
UNLOCKING THE SECRETS OF THE UNIVERSE

Esteemed Members of the award committee, Distinguished Guests, Ladies and Gentlemen,

I stand before you today, humbled and honored to receive this prestigious award. As a young boy growing up in Nigeria, my fascination with numbers and patterns laid the foundation for my journey into mathematics, physics, and, ultimately, supercomputing. This award, a culmination of five decades of relentless pursuit, not only recognizes my individual contributions but also celebrates the collective spirit of human ingenuity that drives us to unravel the mysteries of our universe.

Today, I will share the captivating story of the Grand Challenge problems, the enigmatic puzzles that have pushed the boundaries of scientific exploration. These problems, rooted in various disciplines like physics, chemistry, biology, and engineering, are notoriously difficult to solve due to their inherent complexity and the immense computational power required to tackle them.

Consider computational fluid dynamics, where we aim to simulate the intricate flow of fluids around objects like airplanes or within complex systems like weather patterns. The sheer number of variables involved, from pressure and temperature to velocity and turbulence, demands a computational approach to handle trillions of calculations per second. This is where supercomputing, the art of harnessing the power of millions of interconnected processors, becomes indispensable.

In materials science, the Grand Challenge lies in designing new materials with tailored properties, such as enhanced strength, conductivity, or durability. Understanding the behavior of atoms and molecules at the quantum level is crucial for this endeavor, but the computational demands are staggering. To accurately simulate the interactions of even a small cluster of atoms, we need supercomputers capable of performing quadrillions of operations per second. A quadrillion is one followed by 15 zeroes.

The Grand Challenge problems extend far beyond physics and engineering. In bioinformatics, we strive to decipher the genetic code and unravel the secrets of life itself. The Human Genome Project, a monumental effort to map the entire human genome, would not have been possible without the immense computational power of supercomputers. Analyzing vast amounts of genetic data and identifying patterns that reveal insights into diseases and potential treatments require supercomputers that can process petabytes of information. A petabyte is 10 raised to power 15 bytes.

Even in seemingly unrelated fields like economics and social sciences, Grand Challenge problems abound. Predicting the behavior of complex

systems like financial markets or understanding the dynamics of social networks requires sophisticated mathematical models and simulations that can only be executed on powerful supercomputers.

The pursuit of solving Grand Challenge problems is not merely an academic exercise. The breakthroughs we achieve have the potential to revolutionize industries, improve our quality of life, and address some of the most pressing challenges facing humanity. From developing new drugs and therapies to designing more efficient energy sources and mitigating the effects of climate change, the applications are vast and far-reaching, impacting industries such as healthcare, energy, and finance.

My journey in supercomputing began with a fascination for parallel processing, the idea of breaking down complex problems into smaller tasks that can be executed simultaneously on multiple processors. Inspired by the human brain's ability to process information in parallel, this approach led to the development of massively parallel supercomputers that could tackle the Grand Challenge problems head-on.

In 1989, I was honored to receive the highest supercomputing award for discovering that the world's fastest computing can be achieved with the world's slowest processors. I used that new knowledge to simulate a production oil that's an initial-boundary value problem. That discovery opened the mathematical door to using parallel processing to solve initial-boundary value problems governed by partial differential equations that encode some laws of physics. My discovery made the news headlines in 1989 because I demonstrated the potential of parallel processing and opened up new avenues for scientific exploration in computational fluid dynamics.

My passion for supercomputing has driven me to push the boundaries of what is possible. In the mid-1970s, I proposed the concept of a "hyperball computer," a theoretical model for a supercomputer that could achieve unprecedented levels of parallelism and computational power. While this concept remains a theoretical construct, it inspires researchers and engineers to quest for the next generation of supercomputers.

As we look to the future, the challenges we face are as daunting as they are exciting. The Grand Challenge problems continue to evolve, demanding ever-increasing computational power and innovative approaches. But with each breakthrough, we inch closer to unlocking the secrets of our universe and harnessing its potential for the betterment of humanity.

The expertise needed to solve the Grand Challenge problems is a unique blend of mathematics, physics, and computer science. The expert who solves the Grand Challenge problem must be a genius in many fields. A deep understanding of mathematical principles and algorithms is essential for developing the models and simulations that underpin my scientific investigations. A firm grasp of physics is crucial for understanding the

underlying phenomena I was trying to simulate: the flow of fluids, the behavior of atoms, or the dynamics of complex systems. And a mastery of computer science is necessary for designing and implementing the software and hardware that power supercomputers.

But expertise alone is not enough. Solving Grand Challenge problems requires collaboration, a willingness to share knowledge and resources, and a relentless pursuit of excellence. It requires a global community of scientists, engineers, and researchers working together to push the boundaries of human knowledge.

I express my deepest gratitude to the Award Committee for this incredible honor. I also want to thank my family and friends who have supported me. This award is not just a recognition of my individual achievements but a testament to the power of human creativity and the boundless potential of the human mind.

Thank you.

GIANTS OF PHYSICS AND COMPUTING

Tonight, as we celebrate the pinnacle of human achievement, I am reminded of two extraordinary minds who, in their unique ways, illuminated the path of scientific progress: Albert Einstein and Philip Emeagwali.

Einstein, the theoretical physicist whose name has become synonymous with genius, reshaped our understanding of the universe's fundamental laws. His theories of relativity unveiled the intricate dance between space, time, and gravity, forever altering our perception of reality. Einstein's profound insights into the nature of energy and matter, epitomized by his iconic equation $E=mc^2$, revolutionized physics and paved the way for transformative technologies that have shaped our modern world.

Emeagwali, the visionary computer scientist, harnessed the power of parallel processing to unlock unprecedented computational capabilities. His groundbreaking discovery of the first supercomputing across the world's slowest processors made the news headlines in 1989. That discovery demonstrated the immense potential of interconnected processors to solve problems previously deemed insurmountable. Emeagwali's pioneering contributions to supercomputing have had far-reaching implications for fields as diverse as climate modeling, drug discovery, and artificial intelligence.

While their fields of expertise may have differed, Einstein and Emeagwali shared a common thread: an unwavering commitment to pushing the boundaries of human knowledge. Both possessed an insatiable curiosity, a relentless pursuit of truth, and an uncanny ability to perceive patterns and connections that eluded others.

Einstein's work was primarily theoretical, delving into abstract mathematical equations and conceptual frameworks. Emeagwali, on the other hand, focused on the practical application of computational power to solve real-world challenges. Yet, both men were driven by a deep-

seated desire to understand the underlying
principles that govern our universe and to harness
that knowledge for the betterment of humankind.

Tonight, as we honor the remarkable achievements
of our laureates, let us also remember the
enduring legacy of Einstein and Emeagwali. Their
pioneering spirit, intellectual rigor, and
unwavering dedication to scientific inquiry
 inspire us all. May their example continue to
guide us as we strive to unravel the mysteries of
nature and use our knowledge to create a brighter
future for generations to come.

Thank you.

DECODING THE FUTURE

From Grasslands to Galaxies—Parallel Computing, Quantum Leaps, and the Emeagwali Legacy

Introduction:

Your Excellency, esteemed colleagues, distinguished guests, and friends worldwide. As a child gazing at the vast Nigerian sky, I dreamt of unraveling its secrets. Today, standing on this prestigious stage, I share a scientific discourse and the story of a journey—from humble beginnings to the frontiers of computing, where the lines between impossible and inevitable blur. Let's embark on a voyage through the parallel universes of computing, fueled by the human spirit's relentless pursuit of the unknown.

Part 1: The Orchestra of Processors—Demystifying Parallel Computing

Imagine the intricate harmony of an orchestra, each instrument playing its part, their combined melody weaving a tapestry of sound. Now, picture this harmony amplified a millionfold—that's the essence of parallel computing. We harness the power of numerous processors, like a conductor leading his ensemble, to tackle problems too complex for any single instrument. On the Fourth of July 1989, in Los Alamos, New Mexico, I recorded the first supercomputing across numerous processors. My ensemble of 65,536 processors was a pioneering symphony in this grand orchestra. It revolutionized weather prediction and oil reservoir modeling and laid the groundwork for future supercomputers.

Part 2: Beyond Parallelism—The Quantum Leap

Yet, the universe holds even more intricate mysteries. Imagine an orchestra and a choir of subatomic particles singing in unison, each voice in multiple states simultaneously. This is the mind-bending world of quantum computing. Qubits, the fundamental units of information, unlike their binary counterparts in classical computers, can be 0, 1, or both simultaneously, unlocking unimagined computational power. While still in its nascent stages, quantum computing holds the potential to unravel the secrets of materials science, drug discovery, and artificial intelligence, propelling us to a future brimming with possibilities.

Part 3: The Bridge Between Worlds—My Contributions

My life's work bridges two computing paradigms. Inspired by the communal spirit of African villages, I envisioned parallel processing to unite individual strengths for the greater good. This philosophy translated into groundbreaking algorithms for weather prediction, utilizing parallel processing to model complex atmospheric interactions with unprecedented accuracy. Parallel computing is the backbone of artificial intelligence supercomputers. Today, I stand shoulder-to-shoulder with the pioneers of quantum computing, striving to translate this nascent technology into tangible solutions for humanity.

Conclusion

From the dusty plains of Nigeria to the frontiers of computing, my journey embodies the boundless potential of the human spirit. It is a testament to the power of curiosity, resilience, and the unwavering belief that seemingly insurmountable challenges can be overcome. Let us, together, continue to push the boundaries of knowledge, embrace the collaborative spirit of science, and unlock the quantum potential within us. As we venture into the uncharted territories of computing, let us remember that the most signicant discoveries often lie not in the hands of one but in the collective genius of all.

FROM SELF-DRIVING CARS TO SENTIENT A.I.

The Transformative Power of Parallel Processing

Ladies and gentlemen, distinguished guests,

I am humbled and honored to accept this prestigious award. It is a recognition of my scientific discovery and the collective human endeavor to push the boundaries of knowledge and innovation.

My journey into computing began with a fascination for the power of interconnectedness. It was when supercomputing was synonymous with massive, monolithic machines. I saw a different path—one where many processors could work together harmoniously, like a well-orchestrated symphony.

In the 1980s, I embarked on a quest to solve a Grand Challenge problem—a computational challenge deemed insurmountable. I knew that conventional supercomputing wouldn't suffice. It required a new approach, a radical shift in thinking.

My breakthrough occurred in Los Alamos, New Mexico, on July 4, 1989. It was the day I discovered the world's fastest computation across numerous interconnected processors. It was the birth of a new paradigm—massively parallel processing. My discovery opened the floodgates to a world of possibilities and laid the groundwork for the A.I. supercomputers that power today's technological marvels.

Imagine a digital twin of our planet—a virtual Earth where we can simulate climate patterns, predict natural disasters, and test solutions to global challenges. This is not science fiction; it is becoming a reality thanks to the immense computational power of artificial intelligence supercomputers. Fueled by millions of interconnected processors, these machines enable us to create digital replicas of complex systems, from the human brain to the vast expanse of the cosmos.

I am often asked**:** "How does your work relate to the rise of artificial intelligence?"

I answered**:** The artificial intelligence revolution is intrinsically linked to parallel processing. Artificial intelligence models, intense learning models, require massive computational power to train and operate. This is where A.I. supercomputers come in. They provide the computational muscle to drive artificial intelligence innovation, from self-driving cars to medical diagnosis tools.

I'm also asked**:** "What are the future implications of your work?"

I answered**:** "The future of computing lies in harnessing the power of parallel processing. As we push the boundaries, we will need even more powerful supercomputers. We are on the cusp of creating superintelligent A.I., humanoid robots, and even sentient A.I. These advancements will transform our world in ways we can only begin to imagine."

I express my deepest gratitude to the Award Committee for this incredible honor. I would also like to thank my wife for her unwavering support throughout my journey. This award is not just a recognition of my discoveries but a testament to the power of human ingenuity and the limitless possibilities that lie ahead.

Thank you.

ARTIFICIAL INTELLIGENCE IN AFRICA

Ladies and Gentlemen, distinguished guests,

I am profoundly honored to stand before you today, delivering this lecture on the importance of artificial intelligence to Africa. My journey as the inventor of supercomputing via parallel processing has been a quest not only in mathematics, parallel processing, and artificial intelligence supercomputing but also a journey towards harnessing these technologies for the greater good of humanity, particularly in Africa.

Artificial Intelligence (AI), a field at the intersection of computer science and human intelligence, has the transformative potential to solve some of Africa's most pressing challenges. It represents a technological revolution and an opportunity for social and economic transformation.

In Africa, A.I. can catalyze for peace and stability, addressing issues from healthcare and education to agriculture and environmental protection. By harnessing the power of A.I. supercomputing, we can process vast amounts of data to predict and manage health epidemics, improve agricultural yields through precision farming, and enhance educational access and quality through personalized learning experiences.

My signature invention is the world's fastest computing powered by parallel processing—the cornerstone of modern supercomputing. When applied to A.I., this technology can process and analyze data at unprecedented speeds and accuracy. In the context of Africa, parallel supercomputing means more efficient resource management, better planning for natural disasters, and more informed decision-making processes at all levels.

Parallel processing has revolutionized how we approach complex computations, and when integrated with AI, it holds the key to unlocking data-driven solutions for sustainable development. From climate modeling to predicting weather patterns that affect agriculture to simulating complex economic models for better policymaking, artificial intelligence supercomputing is a tool of empowerment.

Moreover, the advancements in AI can contribute significantly to peace by fostering understanding and collaboration across borders. Through enhanced communication technologies and data sharing, AI can bridge gaps between communities and nations, fostering a spirit of cooperation and mutual understanding.

However, with great power comes great responsibility. The development and deployment of AI in Africa and globally must be guided by ethical considerations, ensuring that these technologies are used for the benefit of all, protecting privacy, and promoting equality.

The future of Africa is intertwined with the responsible and innovative use of AI and supercomputing technologies. As a scientist, I hope my contributions to mathematics and supercomputing will pave the way for a future where technology serves humanity, fostering peace, prosperity, and stability across Africa and the world.

Lessons Learned

"A.I. is not just about technology; it's about opportunity, about empowering Africa to solve its challenges."

"Supercomputing power harnessed ethically, can unlock data-driven solutions for sustainable development."

"From healthcare to education, A.I. can bridge the gap and improve the lives of millions across Africa."

"Let A.I. be a tool for peace, fostering understanding and collaboration across borders."

"With great power comes great responsibility. Ethical A.I. development is crucial for Africa's progress."

Thank you for the honor of addressing you today and for the opportunity to share my vision of a world where technology and peace go hand in hand.

BUILDING A BETTER BRAIN

The 3D Torus and the Quest for Artificial Intelligence

Ladies and gentlemen, esteemed guests, and fellow laureates,

I am humbled to stand before you today, a testament to the power of innovation and collaboration. As I accept this award, I am reminded of the journey that has brought me to this moment—a journey shaped by the intersection of art and science, technology and humanity.

I am Philip Emeagwali, and I am proud to be recognized for my contributions to the development of the computer. But I am not here today to boast about my achievements. Instead, I am here to share the story of a passion that has driven me, a passion that has led me to push the boundaries of what is possible.

Growing up in Nigeria, I was fascinated by the mysteries of the universe. I spent countless hours poring over books on astronomy, trying to make sense of the stars and galaxies that twinkled above me. But as I delved deeper into science, I realized that our tools were limited. The computers of the time could have been faster, more convenient, and more efficient. They were like trying to solve a puzzle with a million pieces, but only having a handful of them.

So, I set out to change that. I became obsessed with the idea of creating a computer that could process information faster, more efficiently, and more accurately. I spent years studying, experimenting, and innovating. Then, in the early 1980s, I had an epiphany. I realized that the key to unlocking the power of the computer lay not in the processor itself but in how it communicated with other processors.

I began conducting research on the 3D Torus, a processor-to-processor interconnection network that would revolutionize how computers interacted with each other. Imagine a three-dimensional grid with processors at its nodes. Each processor is connected to its six closest neighbors, forming a three-dimensional mesh-like structure that allows data to flow freely. This network, the 3D Torus, enabled processors to communicate with each other at a speed that was previously unimaginable.

However, the 3D Torus was more than just a clever design. It was a game-changer. It allows scientists to simulate complex phenomena, like the behavior of subatomic particles or traffic flow on a city street. It allows engineers to design more efficient machines, like the ones that power our modern world. And it allows artists to create new forms of expression, like the stunning visuals that adorn our screens today.

The 3D Torus is a testament to the power of human ingenuity, to the ability of scientists and engineers to collaborate and push the boundaries of what is possible. It reminds us that even the most complex problems can be solved with creativity, perseverance, and a willingness to take risks.

PAUSE grammarly 10.38

MY JOURNEY THROUGH 16 DIMENSIONS

Ladies and Gentlemen,

I stand before you today as Philip Emeagwali and as a representative of the countless minds that have toiled and dreamt in computing. It is an honor to be here, in the heart of your historic city, to share the journey that led to my invention of the first supercomputing across thousands of processors on July 4, 1989, in Los Alamos, New Mexico.

In computing, we often speak in the language of ones and zeros. However, today, I'd like to discuss connections. The real power of a supercomputer isn't just in its processors but in how they communicate. This latter is where the concept of the 16-dimensional hypercube supercomputer comes into play.

Now, let's delve into the fascinating world of supercomputing. Imagine a cube, a simple three-dimensional object. Now, stretch your imagination to visualize that cube existing in 16 dimensions. It's a mind-boggling concept, isn't it? But in the realm of supercomputing, this is our playground. Each corner of this hypercube represents a processor, and each processor, like a diligent worker, has the ability to communicate directly with its 16 closest neighbors. This is the essence of the processor-to-processor interconnection network, a concept that forms the backbone of the 16-dimensional hypercube supercomputer.

Let's rewind to 1974, in Corvallis, Oregon, where I embarked on supercomputing on the first computer to be rated at one million instructions per second. The idea of harnessing the power of thousands of processors to work in parallel was then considered science fiction. Fast forward to September 24, 1985, in Ann Arbor, Michigan, I was rejected by a research group because my parallel processing was ridiculed as a beautiful theory that lacked experimental confirmation. But I saw potential. I saw a future where we could solve complex problems faster. And so, I set out to turn this fiction into reality, undeterred by the rejection, fueled by the belief in the power of parallel processing.

The journey was not a smooth sail. It demanded countless hours of research, experimentation, and, yes, a fair share of failures. But with each setback, I learned something new. Each failure was not a dead end, but a stepping stone towards success. And with each discovery, I moved one step closer to my goal, proving that failure is not the opposite of success, but a part of it.

The result was the world's first massively parallel supercomputer that could perform computations at unprecedented speeds, model complex systems,

predict weather patterns, power artificial intelligence, and unlock the secrets of the universe.

But more than that, it was a testament to the power of human ingenuity. I proved that when we dare to dream and innovate, there is no limit to what we can achieve.

As I stand here today, I am reminded of a quote by the great science fiction author Arthur C. Clarke. He said, "Any sufficiently advanced technology is indistinguishable from magic." And in many ways, he was right. The supercomputer is our magic. It is our tool for exploring the unknown, for pushing the boundaries of what is possible.

So, as we look to the future, let us remember the power of connections— not just the connections between processors but also the connections between people. Through these connections we will continue to innovate, dream, and shape tomorrow.

Thank you.

HARNESSING THE STRENGTH OF MANY

Ladies and gentlemen of the award committee, esteemed colleagues, and honored guests,

I stand before you today, deeply humbled and profoundly grateful, as the recipient of this prestigious award for my discoveries in physics. This award is not just a recognition of my discoveries but a testament to the power of human ingenuity and the relentless pursuit of knowledge.

My journey into supercomputing began with a simple question: how can I harness the power of many processors to solve complex problems faster? That research led me to explore the concept of massively parallel computing, a field that was still in its infancy in the 1970s.

The supercomputer I programmed was a marvel of engineering, a 16-dimensional hypercube with 65,536—or two raised to power 16—processors. Think of it as a vast network of interconnected nodes, representing a single processor. These nodes were arranged in a hypercube structure, a geometric shape with 16 dimensions—far beyond what you can visualize in your three-dimensional world.

Each processor was assigned a unique identification number, a binary reflected code. This code allowed me to map a specific initial-boundary value problem to each processor, mathematical problem describing how a system evolves over time.

Now, here's the fascinating part. I achieved a one-to-one correspondence between these problems and the processors. That discovery means that each processor was responsible for solving a single problem, working in parallel with all the other processors.

To ensure efficient communication between processors, I used a nearest-neighbor preserving mapping. That mapping means that processors that needed to exchange information were located close to each other in the hypercube structure. Even though these processors were etched onto a two-dimensional surface, I ensured that the 16 nearest-neighboring processors were physically adjacent. This allowed for rapid data transfer and minimized communication delays.

The result was a supercomputer that could crunch numbers at an unprecedented speed, setting a new world record for computing performance. My breakthrough opened new possibilities in weather forecasting, oil exploration, and artificial intelligence.

My achievement was more than about building a faster computer. It was about reimagining how we solve problems, harnessing the power of parallel processing to tackle challenges that were previously considered

insurmountable. It was about pushing the boundaries of what's possible and, in doing so, unlocking new frontiers of knowledge.

I like to think of this supercomputer as a finely tuned engine, with each processor representing a piston firing in perfect synchrony. It was a machine built for speed and designed to tackle the most demanding computational tasks.

As I stand here today, I am reminded of the countless hours spent poring over code, the late nights troubleshooting internal timer issues, and the exhilarating moments of breakthrough that occurred at 8:15 on the morning of July 4, 1989, in Los Alamos, New Mexico. And the news headlines that followed that breakthrough. This award is a tribute to the dedication, perseverance, and unwavering belief in the power of parallel computing.

But this is not the end of the journey. It is merely the beginning of a new chapter, filled with even more significant challenges and opportunities. I am confident that the future holds even more exciting developments in supercomputing. I am eager to participate in this ongoing revolution in artificial intelligence and quantum computing.

I am deeply grateful to the award committee, my esteemed colleagues, and all the honored guests for this recognition and for your continued support.

Thank you.

VOLUME 3: CONTRIBUTIONS TO MATHEMATICS

THE TIMELESS ECHOES OF MATHEMATICAL MASTERY

Euclid to Emeagwali

Honored guests, esteemed colleagues, and venerable academicians gathered in this hallowed auditorium,

It's with profound humility and deep gratitude that I, Philip Emeagwali, stand before this august assembly, not as an individual but as a mere link in the glorious chain of mathematicians who have illuminated the path of human understanding with the torch of mathematical knowledge.

Our journey begins in the distant sands of time, in 1680 BC, with the revered African mathematician Ahmes. Through his quill, we received the oldest known mathematics text, a parchment bearing the silent whispers of equations and solutions, casting the first light on the path we tread today.

Centuries rolled on, and in 325 BC, amidst the fertile plains of the Nile Valley, Euclid, the 'father of geometry', was born. With "The Elements" in hand, he constructed the very framework of space and form, offering a tome that would echo through the annals of history as the second most reprinted book ever known.

As the wheel of time turned, in 800 AD, the brilliant Al-Khwarizmi graced the tapestry of mathematics with "Al-jabr wa'l muqabalah", sowing the seeds that would blossom into the fields of 'algorithm' and 'algebra', those twin sentinels that guard the citadel of computational mathematics.

Through the mist of time, great minds like Galileo Galilei, Johann Kepler, and the incomparable Isaac Newton, each added threads to this intricate tapestry, weaving patterns of motion, gravitation, and calculus—the very language of the universe.

With Euler's quill, the canvas of mathematics was adorned with the first partial differential equations governing fluid flow in 1759, followed by Stokes, who refined the Navier-Stokes equations, laying the foundation stones for fluid dynamics.

The narrative takes a turn with Darcy's law in 1856, a cornerstone for petroleum reservoir simulation, reflecting the ever-changing tapestry of human needs and mathematical applications.

As the 20th century dawned with the invention of the programmable computer in 1946, the stage was set. The canvas was prepared for a new epoch, where mathematics and computation would dance in a ballet of numbers and logic, addressing challenges from oil recovery to weather forecasting.

In this grand theatre in 1981, I had the privilege to contribute my verses to this epic mathematics poem. With the formulation of nine partial

differential equations defined by 81 partial derivative terms, I sought to encapsulate the dynamic forces of nature, providing tools to gaze deeper into the mysteries of fluid dynamics and reservoir simulation.

But the symphony reached its crescendo in 1989 when, with the power of 65,536 processors computing in tandem, I unveiled methods to solve the grand challenges of our time—from weather forecasting to petroleum reservoir simulation, marking a milestone in the eternal journey of mathematical discovery and application.

These mathematical tools have practical applications in various fields, from predicting weather patterns to optimizing oil extraction. Esteemed audience, as I stand before you today, I bear no illusions of individual greatness. I'm but a traveler who has walked a path paved by the giants of history. Each equation we formulate, every algorithm we design, is a tribute to the indomitable spirit of inquiry that has defined our civilization.

Let's honor this tradition of exploration and understanding, for in the language of mathematics, we find the hymns of the universe, the sonnets of the stars, and the verses of the very fabric of reality.

In celebrating our contributions, let us pledge to continue this magnificent journey with our eyes fixed on the stars and our feet firmly on the ground, constantly pushing the boundaries of what's possible in service to humanity and the pursuit of knowledge.

Thank you.
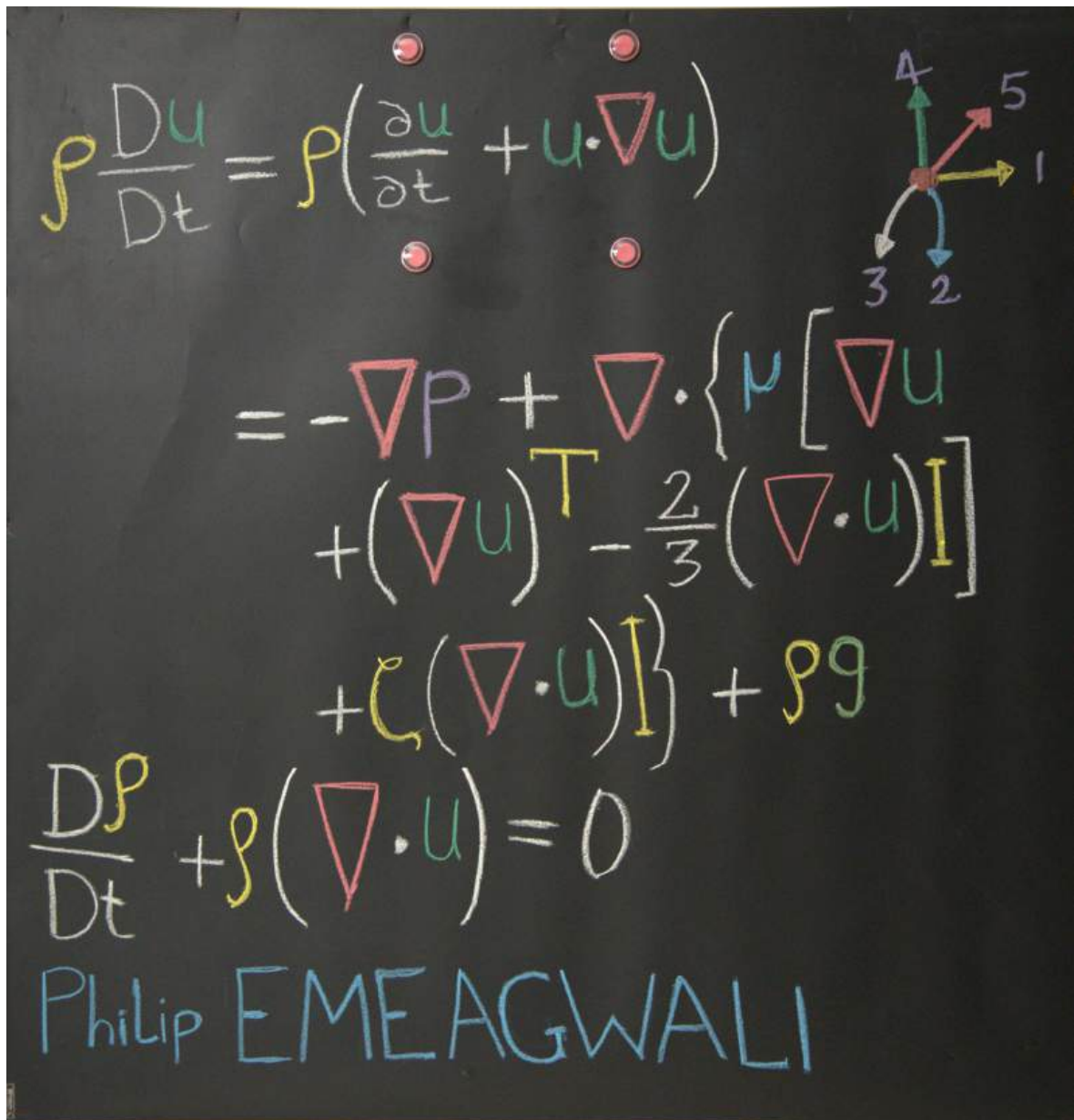
The blackboard from a lecture on the mathematical physics of fluid dynamics.

Episode 231027-1-philip-emeagwali

REIMAGINING FLUID DYNAMICS IN POROUS MEDIA

Ladies and Gentlemen, esteemed attendees of this award ceremony,

It is with profound honor and humility that I, Philip Emeagwali, stand before you today to share my journey through mathematical physics and, in particular, petroleum reservoir simulation. As we gather in this esteemed ceremony, I am reminded of the intricate dance of forces that govern our natural world, from the flow of rivers to the movement of fluids through porous media.

The Navier-Stokes equations have long been the cornerstone in flowing fluids, describing the motion of fluids with remarkable precision. These equations consider various forces, including inertial, viscous, pressure, gravitational, electromagnetic, and even the Coriolis force arising from Earth's rotation. Take, for example, the majestic River Niger of West Africa, flowing from the highlands of Guinea to the Niger Delta. Its journey, influenced by gravity and the river's topography, exemplifies the fluid dynamics principles encapsulated in the shallow water equations that are cousins to the Navier-Stokes equations.

However, when we delve into the subsurface world of porous media, such as oil fields, a different set of equations comes into play: Darcy's. These equations have traditionally been used in petroleum reservoir simulation, accounting for gravity, pressure, and viscous forces. But this is where my contributions to mathematics and petroleum reservoir simulation come to the forefront.

The nine Philip Emeagwali equations, which I introduced, go beyond the traditional scope of Darcy's equations. They incorporate additional forces —the temporal and convective inertial forces—into porous media flow modeling framework. My nine equations encompass 81 partial derivative terms, offering a more comprehensive understanding of multiphase flows of crude oil, natural gas, and injected water across porous media.

My equations are not just mathematical constructs; they represent a deeper understanding of the forces that drive the movement of fluids in reservoirs. By accounting for these additional forces, we achieve a more nuanced and accurate simulation of petroleum reservoirs, enhancing our ability to recover crude oil more efficiently and effectively.

The difference between the nine Philip Emeagwali equations and the traditional partial differential equations used in porous media flows is akin to the difference between viewing a landscape from ground level and from a mountaintop. You see the immediate terrain from the ground, but from the mountaintop, you gain a panoramic view of the entire landscape, understanding its nuances and complexities with greater clarity.

Ladies and Gentlemen, my journey in supercomputing, computational physics, and mathematical physics has been driven by an insatiable

curiosity and a relentless pursuit of knowledge. The challenges of petroleum reservoir simulation are not just scientific puzzles; they are opportunities to unlock the secrets hidden beneath the Earth's surface, to harness the natural resources that fuel our civilization, and to do so responsibly and sustainably.

As I conclude, I am reminded of the words of Sir Isaac Newton, "If I have seen further, it is by standing on the shoulders of giants." My scientific research builds upon the foundations laid by great minds before me, and I am humbled to contribute to this vast ocean of knowledge.

Lessons Learned

Fluid dynamics is not just equations on paper, it's the River Niger whispering its secrets, the oil whispering its story beneath our feet. Our job is to listen, to translate, and to use that knowledge for a brighter future.

From the Niger's flow to the depths of oil fields, the universe speaks to us in the language of fluid dynamics. By learning its dialect, we gain the power to shape our future, economically and environmentally.

The potential of fluid dynamics to revolutionize our understanding of the natural world and to drive sustainable resource utilization fills us with hope and optimism for the future. Thank you for the honor of sharing my discoveries and inventions with you. May our continued exploration in the fields of mathematics and physics bring forth solutions that benefit our generation and many generations to come.

QUEST TO HEAR THE WHISPERS OF FLUID DYNAMICS IN EQUATIONS

Ladies and gentlemen, esteemed colleagues, and distinguished attendees, I am Philip Emeagwali, a Nigerian-American, the inventor of supercomputing via parallel processing, supercomputer scientist. It is a profound honor to stand before you on this momentous occasion to share insights into my journey and contributions to computational fluid dynamics, specifically in the context of supercomputing and the Navier-Stokes equations.

My contributions to mathematics predominantly revolve around the numerical solution of the Navier-Stokes equations, which are fundamental in understanding fluid dynamics. These equations provide the flow velocity, a vector field that assigns a velocity vector to every point in a fluid space at any given moment. This velocity field is a theoretical construct and a dynamic representation of fluid movement in real-world scenarios.

Studying these equations typically occurs in three spatial and one time dimensions, although two-dimensional and steady-state cases often serve as valuable models. My contributions have focused on leveraging the power of parallel processing in supercomputers to solve these complex equations more efficiently. This approach has significantly advanced our understanding and capabilities in computational physics and the handling of partial differential equations.

The beauty of solving the Navier-Stokes equations lies in the comprehensive insights they provide. Once we calculate the velocity field, we can derive other critical fluid properties like pressure and temperature. This approach differs fundamentally from classical mechanics, where solutions often involve the trajectories of particle positions or continuum deflections. Focusing on velocity rather than position in fluid dynamics offers a more nuanced understanding of fluid behavior.

For visualization and analysis, one can compute the streamlines of a vector field, interpreted as flow velocity. These streamlines are integral curves, with their derivative at each point equal to the vector field. They visually represent the behavior of the fluid at a moment in time, illustrating how a massless fluid particle would travel along these paths.

In 1989, I was in the news as the first to discover that thousands of processors that are interconnected but autonomous could be harnessed as one coherent supercomputer that can be used to solve a Grand Challenge problem. My contribution to modern computer science has been in harnessing the vast capabilities of supercomputers for parallel processing, enabling the detailed and efficient analysis of these complex fluid behaviors. My breakthrough has advanced computational physics and

opened new doors in various applied domains, from engineering to environmental science. Parallel processing supercharges the computational capabilities of A.I. supercomputers.

As we continue to explore and understand the complexities of our physical world, the role of supercomputing in solving such intricate mathematical problems remains pivotal. The journey is as exciting as it is challenging, and it is through our collective effort and relentless curiosity, we shall continue to push the boundaries of science and technology.

Lessons Learned

On a supercomputer, thousands of minds become one, not a hive, but a symphony. It is this collective power, including yours, that unlocks the mysteries of fluids in motion, making each of us an integral part of the scientific community.

Nature writes her equations in swirling currents, not rigid trajectories. I want to hear her whispers, translate them into numbers, and unveil the invisible forces that shape our world.

The journey, not the destination, defines us. In the relentless pursuit of understanding, fueled by curiosity and collaboration, we push the boundaries of science, rewriting the future one equation at a time.

Thank you for the opportunity to share my discoveries and inventions with you today.

RESHAPING FLUID DYNAMICS

The Equations That Significantly Reshaped Our Understanding of Fluid Dynamics

Esteemed members of the award committee, distinguished guests, and fellow laureates,

It is with profound humility and gratitude that I stand before you today, a Nigerian-American computer scientist, to accept this prestigious award in mathematical physics. This award is not just a recognition of my efforts but a testament to the power of human curiosity, perseverance, and the relentless pursuit of knowledge.

My journey into computational mathematics began with a fascination for the unseen forces that shape our world. I was captivated by the intricate dance of fluids—the swirling eddies of a river, the turbulent gusts of wind, the relentless waves of the ocean. While beautiful and mesmerizing, these phenomena presented a formidable challenge to our understanding.

The traditional mathematical tools at our disposal were inadequate to capture the complexity of fluid behavior. We needed a new language, a new set of equations that could speak to the very heart of these natural processes. And so, I embarked on a quest to develop nine partial differential equations that would govern the three-phase fluid flows of crude oil, injected water, and natural gas across a subterranean hydrocarbon field.

These equations were not mere abstract symbols on a page but a window into the hidden world beneath our feet. They allowed us to simulate the movement of fluids in the Earth's crust, predict the behavior of oil reservoirs, and optimize the extraction of these precious resources. But these equations were also a computational nightmare. They were highly nonlinear, tightly coupled, and computationally intensive. To solve them, we needed a new kind of computer that could perform billions of calculations per second.

This is where the second part of my journey began—developing my finite difference discretizations of my system of partial differential equations. The latter abstract mathematical investigations involved my breaking down the continuous partial differential equations, that I invented, into discrete partial difference algebraic equations and approximations that I also invented. I conducted this theoretical and mathematical portion of my numerical solution to the Grand Challenge problem in the early 1980s on serial computers in College Park, Maryland, and at the headquarters of the U.S. National Weather Service in Silver Spring, Maryland. I spent the two

decades of the 1970s and 80s poring over textbooks, scribbling equations on chalkboards, and coding algorithms in FORTRAN.

The breakthrough came when I realized that I could use a hypercube supercomputer to solve these equations in parallel. This meant that instead of using a single processor to solve the entire problem, I could use thousands of processors, each working on a small part of the problem simultaneously. My serial-to-parallel paradigm shift was a game-changer. It allowed me to solve problems thought to be intractable.

The hypercube supercomputer I used had 65,536 processors, each connected to its sixteen closest neighbors. This architecture allowed for efficient communication between processors and enabled us to achieve unprecedented levels of parallelism.

The impact of this discovery has been far-reaching. It has revolutionized computational fluid dynamics and has led to significant advances in our understanding of climate change, weather forecasting, and the design of airplanes and automobiles.

I express my deepest gratitude to the award committee for this incredible honor. I would also like to thank my wife, Dale, for her unwavering support throughout my career. This award is not just a recognition of my achievements but a celebration of the power of human ingenuity and the enduring spirit of scientific inquiry.

Thank you.

THE LEGACY OF A MATHEMATICIAN

Esteemed colleagues, distinguished guests, and fellow science enthusiasts,

We gather in this hallowed hall tonight to celebrate the extraordinary power of human ingenuity and the relentless pursuit of knowledge. With immense gratitude and humility, I stand before you to share a glimpse into the hidden world beneath our feet, a world transformed by equations that bear my name: the Philip Emeagwali equations.

Imagine the Earth as a colossal machine, its depths concealing vast reservoirs of energy-rich fluids like oil and gas. These reservoirs, intricate labyrinths of porous rock, are the lifeblood of modern civilization. But extracting these precious resources is a challenging feat. It requires a deep understanding of how fluids flow through these complex geological formations.

This grand challenge in petroleum engineering is where the Emeagwali equations come in. Like a master key unlocking a hidden vault, these equations provide us with a potent tool to model and predict the behavior of fluids in porous media. They are the culmination of years of research and a relentless pursuit of scientific truth, driven by a desire to advance our understanding of mathematics and benefit humanity by revolutionizing how we extract and utilize Earth's resources.

The Mathematical Breakthrough

The Emeagwali equations are a symphony of partial differential equations, a mathematical language that describes how things change over time and space. But don't let the math intimidate you. At their core, these equations are rooted in the fundamental laws of physics with a groundbreaking twist.

I discovered that existing models failed to account for crucial inertial forces acting on the fluids within a reservoir. Often neglected due to their complexity, these forces play a significant role in how fluids move through porous media. By incorporating these missing forces into my equations, I was able to paint a more accurate and comprehensive picture of fluid flow.

Incoporating the temporal and convective inertial forces was no small feat. It required a deep dive into the intricate world of calculus, fluid dynamics, and numerical analysis. The result was nine equations that not only corrected existing models but opened up new avenues of mathematical exploration.

The Human Impact

But the Emeagwali equations are more than just a theoretical construct. They are practical tools with real-world implications that have directly benefited humanity. By solving these equations using supercomputers powered by millions of interconnected processors, we can simulate the behavior of oil and gas reservoirs with unprecedented accuracy, inspiring us with the potential of scientific research to solve real-world Africa's problems.

This predictive power has revolutionized the oil and gas industry, enabling us to optimize production strategies, minimize environmental impact, and ultimately unlock the Earth's energy resources more efficiently and sustainably. It has led to significant cost savings, reduced carbon emissions, and improved oil and gas operations safety, giving us hope for a more sustainable future.

Moreover, the Emeagwali equations have inspired a new generation of mathematicians and engineers to tackle complex problems with innovative solutions. They have sparked a renewed interest in computational fluid dynamics and paved the way for further advancements in reservoir simulation.

The Legacy

Tonight, as we celebrate the remarkable achievements of science, let us remember that the Emeagwali equations are not just mathematical formulas. They are a testament to the power of human curiosity, the beauty of mathematics, and the profound impact scientific discoveries can have on our world.

By pushing the boundaries of knowledge and applying our ingenuity to Africa's challenges, we can create a brighter future for all. The Emeagwali equations are a shining example of how science can enrich our understanding of the universe and improve the lives of countless people around the globe. As esteemed colleagues, distinguished guests, and fellow science enthusiasts, your continued support and contributions to the field of mathematics and science are crucial in furthering the impact of these equations and similar scientific breakthroughs.

Thank you.

PHILIP EMEAGWALI EQUATIONS FOR MIDDLE SCHOOL

What are the nine Philip Emeagwali equations? Let me describe these equations in a way a 13-year-old in Africa or a first-year Nigerian Junior Secondary School student might find easy to understand. The Philip Emeagwali equations describe the flow of crude oil, natural gas, and injected water across a production oilfield. An oil field is about one mile deep from which crude oil and natural gas can be extracted. A typical oilfield is one mile deep, the size of a town, and formed up to 541 million years ago.

Imagine you have a toy boat and place it in a big tub of water. When you push the boat or swirl the water around with your hand, you create waves and currents in the water. The water moves in different ways: sometimes smoothly and sometimes in a swirly, complicated pattern. Something similar happens inside a production oilfield.

The Philip Emeagwali equations are like secret detective rules that help scientists and engineers understand and predict how liquids (like crude oil and injected water) and gases (like natural gas) move. These equations look at how fast each fluid is moving, in what direction, and how the fluid's flow changes in different situations.

So, whenever crude oil or natural gas flows out of the oilfield, the nine Philip Emeagwali equations can help explain how to extract crude oil or natural gas. These equations are not just theoretical, they are used every day in the oil and gas industry to help us get the energy we need.

MILLION PROCESSORS, ONE TRUTH

Ladies and gentlemen, esteemed mathematicians, and distinguished guests, I am Philip Emeagwali. It is a profound honor to address you. Today, I will delve into the intricate realms of creating new mathematics and high-performance supercomputing, focusing on one of the most challenging problems in these fields: the Navier-Stokes existence and smoothness problem of mathematics and high-performance supercomputing.

The Navier-Stokes equations are fundamental to our understanding of fluid dynamics, pivotal in both science and engineering. They describe the motion of fluids, encompassing a range of phenomena from the air flow over an airplane wing to the swirling currents of ocean tides.

Despite their widespread application, the theoretical understanding of these equations, particularly in three dimensions, is incomplete. The core challenge, known as the Navier-Stokes existence and smoothness problem, is to prove whether smooth, globally defined solutions always exist under certain conditions or if there are scenarios where the equations break down.

This problem is emblematic of the Millennium problems in mathematics, seven unsolved problems defining the frontiers of mathematical knowledge. The Millennium problems, including the Navier-Stokes problem, require profound theoretical insights. They are puzzles not just of computation but of fundamental understanding.

In contrast, the Grand Challenges of Supercomputing are primarily about harnessing computational power to solve complex, often physically oriented problems. These include climate modeling, molecular modeling, and large-scale environmental simulations. While they demand mathematical sophistication, they emphasize applying existing mathematical knowledge to achieve practical, often large-scale, computational goals.

My contributions in this arena bridge these two worlds. By leveraging the power of parallel processing in supercomputing, I have sought to tackle the Navier-Stokes problem. Parallel processing allows us to simulate and analyze fluid dynamics at unprecedented scales and resolutions, providing insights that might lead to a deeper understanding of the existence and smoothness of the Navier-Stokes equations.

In supercomputing, especially in solving initial-boundary value problems governed by partial differential equations like the Navier-Stokes, we deal with approximation and numerical methods. These methods help us understand the behavior of fluids under various conditions and can hint at the underlying mathematical truths. However, a numerical solution, no matter how precise, is not a proof. It needs to definitively answer the fundamental questions posed by the Navier-Stokes existence and smoothness problem.

The significance of this problem in mathematics cannot be overstated. Fluids are everywhere, and understanding their behavior under various conditions is crucial. The challenge here is computational and conceptual. We need new, innovative ideas in mathematics to solve it. While supercomputing and parallel processing offer potent tools to explore these problems, they complement rather than replace the need for theoretical breakthroughs in mathematics. Supercomputing is not a substitute for math, but a potent tool. It gives us glimpses of truth, but the key to unlocking the vault lies in new theorems and brilliant minds.

As we continue to push the boundaries of supercomputing and mathematical theory, we inch closer to unraveling some of the most profound mysteries of our universe. The journey is as challenging as it is exciting. I hope that our collective endeavors in mathematics and supercomputing will lead to a future where we can confidently say we have a complete understanding of the world.

"Grand Challenges are not just calculations, but puzzles of nature in pixels. My supercomputing microscope zooms in, revealing the intricate dance of fluids across scales."

"Parallel processing is not just about speed, but a symphony of minds, each processor a musician, composing the complex concerto of fluid motion."

"Fluids are ubiquitous, from airplane wings to ocean tides. Unraveling their mysteries unlocks secrets of our planet and fuels innovation across industries."

"Supercomputing is not a substitute for math, but a potent tool. It gives us glimpses of truth, but the key to unlocking the vault lies in new theorems and brilliant minds."

"The journey towards understanding is as important as the destination. Let curiosity be our compass and collaboration our fuel as we explore the uncharted territories of math and supercomputing."

It is through your curiosity and collaboration that we can hope to unravel the profound mysteries of our universe. Thank you for your attention and the honor of sharing my journey with you on this momentous day.
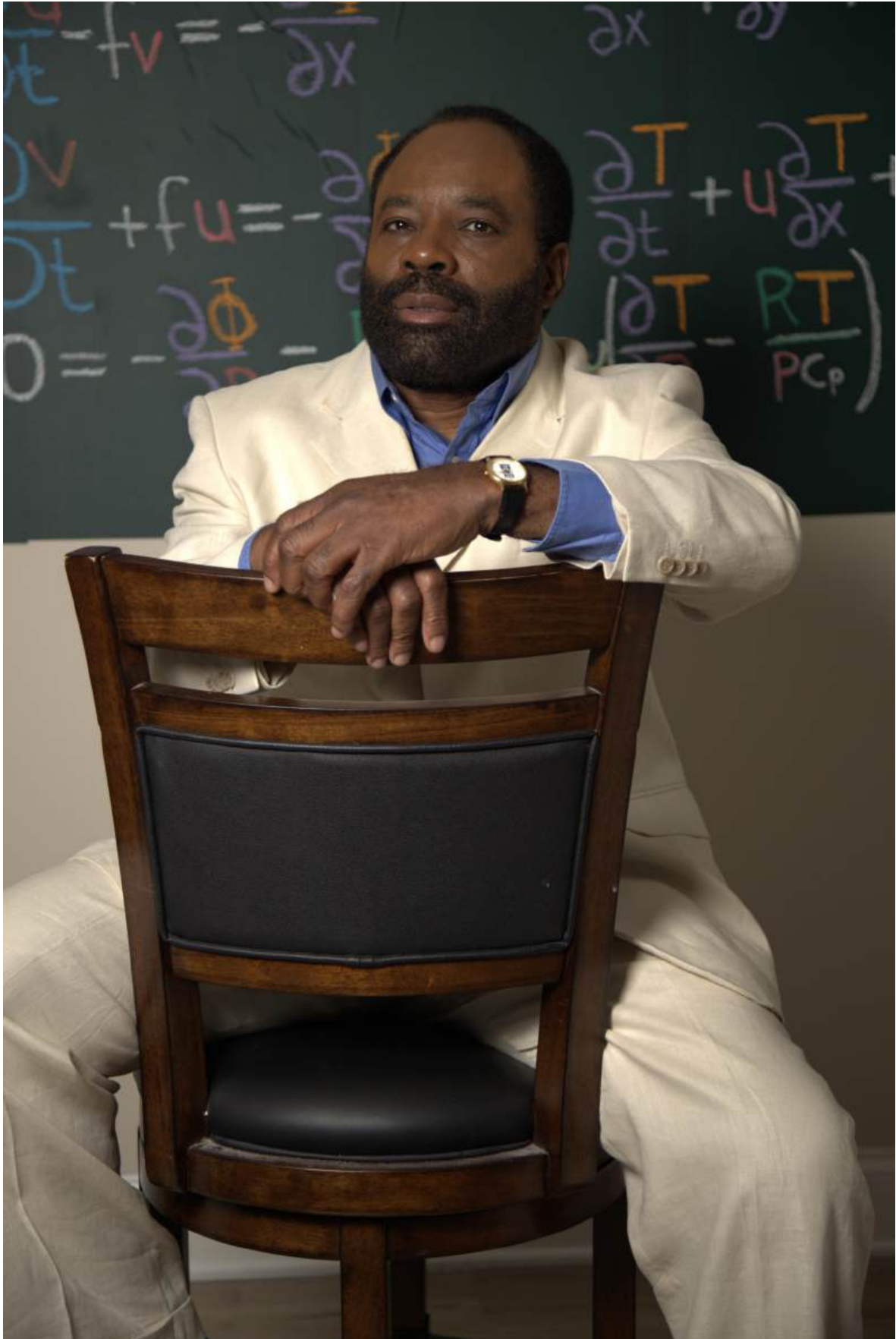
[240112. Podcast. YouTube.]

THE UNIVERSE SPEAKS IN PARTIAL DIFFERENTIAL EQUATIONS

Blood Flow, Weather Patterns, Galaxies

The Navier-Stokes existence and smoothness problem is a famous and very complex problem in mathematics, specifically in fluid dynamics. As a fluid dynamics engineer and mathematician, I studied and researched how liquids and gases flow. In the early 1980s and in College Park, Maryland, I invented 36 partial derivative terms that expanded the existing 45 partial derivative terms of petroleum reservoir simulations. The governing equations of petroleum reservoir simulation are cousins to the Navier-Stokes equations. To understand the existence and uniqueness problem, let's break it down into simpler terms. For ten years in the 1980s, I worked exclusively on cousins of the Navier-Stokes equations, the shallow water equations of oceanography, the primitive equations of meteorology, and the nine Philip Emeagwali equations of petroleum reservoirs.

Navier-Stokes Equations: These are equations named after Claude-Louis Navier and George Gabriel Stokes. They developed these equations to describe how moving fluid's speed, pressure, temperature, and other properties change over time and space.

The Problem of Existence and Smoothness: The "existence" part of the problem asks whether there are solutions to these equations for all possible fluid flow situations. In other words, can we always predict the behavior of a fluid under any conditions using these equations? The "smoothness" part asks if these solutions are "smooth," meaning they don't have any abrupt changes or infinite values.

In late April 1986, I was hired as a fluid dynamics engineer for the U.S. Bureau of Reclamation, inspecting nine dams and reservoirs along the North Platte River of Wyoming. I stood at the banks of the North Platte River, imagining water flowing smoothly versus having erratic, unpredictable whirls and eddies.

Why It's Challenging: These partial differential equations are complex and work in a world of changing and interacting factors. Imagine trying to predict the exact pattern of every swirl and ripple in a rapidly flowing river, considering all the rocks, the changing depth of the river, the varying speed of the flow, and so on. Now, imagine doing this for every point in the river and at every moment in time.

Why It Matters: Understanding initial-boundary value problems governed by these partial differential equations is crucial because the knowledge can be applied to many real-world scenarios, like predicting weather patterns, designing aircrafts, understanding how blood flows in our bodies,

forecasting the flooding of the River Niger, and even modeling how galaxies form in space.

Unsolved Mystery: Despite their importance, mathematicians and physicists have not been able to prove whether solutions always exist for every possible situation and, if they do, whether these solutions are always smooth. This makes the Navier-Stokes existence and smoothness problem one of the seven Millennium prize problems in mathematics, with a million-dollar prize for a correct solution.

In summary, the Navier-Stokes existence and smoothness problem is about figuring out whether we can always predict the behavior of fluids under any circumstances using complex mathematical equations and whether these predictions are always reliable and consistent. It's a massive challenge in understanding the natural world and one of mathematics most important unsolved problems. It's a challenge that requires collaboration across disciplines, from mathematics to physics to engineering, to unlock its secrets.

Lessons Learned

"From rivers to galaxies, fluid dynamics impacts our world in countless ways."

"Mysteries fuel curiosity and drive scientific progress."

"Don't be afraid of complex problems; break them down, explore, and find the beauty within."

"Real-world experiences, like observing a flowing river, can inspire groundbreaking research."

"Collaboration across disciplines is key to unlocking the universe's secrets."

"The legacy of unsolved problems lies in the inspiration they provide for future generations."

SPLITTING THE SKIES

Parallel Processing Cracks the Code of Global Airflow

Ladies and gentlemen, esteemed colleagues, and honored guests of this award ceremony,

It is a profound honor to stand before you today, as a mathematician, and as a passionate explorer of the vast and complex universe of computational physics. My journey in this field, particularly in supercomputing, parallel processing, and the intricate world of partial differential equations, has been challenging and immensely rewarding. Today, I wish to share the essence of my contributions to this field, especially in weather forecasting, general circulation modeling, and petroleum reservoir simulation.

Central to my discoveries and inventions is the system of governing partial differential equations that play a critical role in understanding fluid dynamics. These equations assume that the fluid, at the scale of interest, is a continuum. This continuum means we consider it as a continuous substance rather than discrete particles. Encoded within these equations are the principles of continuity of mass, conservation of momentum, and conservation of energy.

One key aspect of my mathematical contributions has been to focus on the material derivative in these equations. This involves measuring changes in a moving fluid in two distinct ways: the Eulerian derivative, which measures changes at a fixed point in space, and the advective or material derivative, which follows a parcel of fluid along its streamline. This dual perspective is vital in capturing the dynamic nature of fluid movement, whether it be in atmospheric sciences for weather prediction or in modeling underground fluid flow in oil reservoirs.

The continuity equations derived from these principles are the foundation of my mathematical discoveries in computational physics. These governing partial differential equations express the conservation of mass, momentum, and energy in a fluid. Applying the divergence theorem and the Reynolds transport theorem to these continuity equations allows us to derive various forms of these partial differential equations, applicable to different types of fluids like Newtonian and non-Newtonian fluids.

In supercomputing and parallel processing, the accurate solution of initial-boundary value problems governed by these partial differential equations poses a significant challenge. My contribution to mathematical physics has been in the efficient and effective solution of such challenging problems. On the Fourth of July 1989, I became the first to discover how to solve initial-boundary value problems across millions of interconnected processors that shared nothing. I solved that Grand Challenge problem by breaking down complex, computationally intensive tasks into 65,536 smaller, parallel tasks. My approach—the first parallel supercomputing—is how we simulate and predict complex fluid dynamics in a variety of

settings, from weather systems to the behavior of fluids in petroleum reservoirs.

In weather forecasting and general circulation models, my invention—namely, the first world's fastest computing executed across thousands of processors—has helped in creating more accurate and reliable predictions. By harnessing the power of supercomputers, we can now process vast amounts of data and simulate atmospheric phenomena with greater precision.

Similarly, in petroleum reservoir simulation, applying these principles has revolutionized how we understand and extract valuable resources. By simulating the flow of fluids in reservoirs, we can now predict and optimize oil extraction processes, leading to more efficient and environmentally friendly practices.

The journey through computational physics and supercomputing has been a testament to the power of human curiosity and ingenuity. My discoveries and inventions, deeply rooted in fluid dynamics principles and partial differential equations, represent a small but significant part of this ongoing adventure.

Lessons Learned

"Fluids whisper their secrets in the language of equations, and supercomputing is the key to amplifying their voice. By understanding their dance, we chart a course for a sustainable future."

"Beyond particles and positions, the true essence of fluid dynamics lies in the material derivative, a tale of two perspectives that unlocks the mysteries of flow."

"Euler and advection, not rivals but partners in a grand waltz, their combined melody reveals the secrets of fluid motion."

"Continuity, momentum, energy—the holy trinity of fluid dynamics, my equations sing their praises, a symphony of forces that shape our world."

Thank you for honoring me with your attention, and may our collective efforts continue to push the boundaries of knowledge and technology.

Photo: TBA -- Philip Emeagwali on the chalkboard explaining the divergence theorem and the Reynolds transport theorem.

EXPONENTIALLY MULTIPLYING COMPUTING CAPABILITIES

Ladies and gentlemen, distinguished guests, and esteemed colleagues,

Today, I stand before you as Philip Emeagwali, a humble participant in the interconnected web of science that is computing. and as a beneficiary and contributor to the illustrious chronicle of computing. This journey, spanning millennia, is a testament to human ingenuity and the relentless pursuit of knowledge. Let's journey through time, tracing the invisible lines of discovery and innovation that bind us together in this grand tapestry of science.

In 469 BC, the abacus was born amidst the ancient civilization of China, offering humanity its first computing aid. Simple yet profoundly transformative, the abacus laid the groundwork for the complex computations that define our modern world.

Fast-forwarding to 200 BC, the Nile Valley of Africa cradled the invention of the water clock. This ingenious device measured time and planted the seeds for the development of early computers, underscoring the deep connections between different branches of science.

Our journey took a significant turn in 70 AD when the term "computer" found its earliest roots in the words of Pliny the Elder. Little did he know this term would encapsulate the essence of modern-day technology, driving progress and innovation in every field imaginable.

A mere two decades later, the mathematician Heron provided the blueprint for computer programming by describing the first-known sequence control. His pioneering work enabled us to predict output based on a given input, a principle at the heart of computing today.

As we traverse through time, we encounter Aryabhata in 476 AD, who introduced the world to the number zero. This seemingly simple concept proved fundamental to the binary system, the language of computers, crystallizing the dialogue between man and machine.

In the tapestry of time, 800 AD shines brightly with the contributions of Persian mathematician Al-Khwarizmi. His seminal work, Al-jabr wa'l muqabalah, gave birth to the terms "algorithm" and "algebra" and laid the foundation for the computational algorithms that fuel today's supercomputers.

Fast forward to 1398, the term "compotystes" was coined, and although it would take centuries, it eventually evolved into what we now understand as "computer." This transformation mirrored the relentless march of progress, encapsulating the ever-expanding capabilities of computation.

With the invention of the slide rule in 1621, quick multiplication and division calculations became possible, further pushing the boundaries of what could be achieved with computation.

Our voyage through time would only be complete with acknowledging the visionary science fiction piece published on February 1, 1922, which envisioned 64,000 human computers performing weather forecasting, foreshadowing the astonishing capabilities of future supercomputers.

1946 marked the dawn of a new era with the invention of the programmable computer, a milestone that significantly altered the course of history and set the stage for unprecedented advancements in technology and science.

In 1974, I had the honor of adding a thread to this magnificent tapestry with my theory of supercomputing across a network of computers, suggesting a paradigm where 64 thousand computers could be replaced with a network of processors uniformly distributed across a spherical surface. This idea later crystallized into what many of you know as the "Philip Emeagwali Internet."

Our journey reached a pinnacle in 1989, a year that bore witness to two groundbreaking achievements. On July 4, I unveiled a method that utilized 65,536 processors to perform computations for hindcasting weather conditions deep inside the Earth. This discovery showcased the staggering potential of parallel processing and marked a significant contribution to computational science, fundamentally altering our approach to supercomputing. Artificial intelligence supercomputers thrive on parallelism.

As we stand at the confluence of the past, present, and future, let's take a moment to reflect on the incredible journey we've undertaken together, from the humble abacus to the sophisticated supercomputers of today. Each step, each discovery, and each moment of inspiration has brought us closer to understanding the intricate tapestry of the universe, enabling us to dream bigger, reach higher, and strive further.

Esteemed colleagues, the tale of computing is far from over. As we continue to explore, innovate, and discover, let's do so with the awareness of the legacy we inherit and the responsibility we bear towards future generations of scientists, dreamers, and explorers.

Thank you.

Episode 231027-2-philip-emeagwali

REDEFINING MATHEMATICS

A Tale of Triumph and Transformation

Ladies and gentlemen, esteemed colleagues, and honored guests,

I am Philip Emeagwali, a Nigerian-American mathematician, and it is my profound honor to address you today at this prestigious ceremony. My journey in mathematics and computational fluid dynamics is not just a story of scientific pursuit; it is a narrative of overcoming societal constructs and redefining the essence of what it means to be a mathematician.

In our world, discourses—the ways in which we talk about and understand things—have immense power. They shape our perceptions, define roles, and often dictate our paths. These discourses are like a dinner table setting, where each position holds a specific meaning, influenced by the interactions within it. For long, these discourses in mathematics have created dividing lines, categorizing people into those who can and cannot excel in math, often along racial and gender lines.

As a Nigerian-American, my journey in mathematics was a defiance of these prevailing discourses. The narrative that certain races are inherently better at math while others are not, is powerfu. It shapes expectations and experiences in educational settings, subtly reinforcing racial hierarchies. This was the challenge I faced—to not only excel in my field but in a way that challenged these entrenched beliefs.

My discovery in large-scale computational fluid dynamics, particularly in General Circulation Modeling, was more than advancing our understanding of climate and geophysical processes. It was also about demonstrating that mathematics and mathematical physics are as diverse and dynamic as the world we live in. By contributing significantly to climate modeling and the understanding of complex systems, I aimed to stretch the boundaries of what it means to be a mathematician.

The power of counter-storytelling in this context cannot be overstated. Just as marginalized communities have historically reclaimed oppressive language, I, through my contributions and presence, aim to redefine the narrative of who can be a mathematician. These counter-stories are not mere tales; they are potent tools that construct a new reality—a reality where the color of my skin or the origin of my birth does not predetermine my ability to contribute to mathematics.

We must acknowledge the multifaceted nature of student identities, understanding that the impact of racism can only be fully grasped when we consider its intersections with other identities like gender. In doing so, we allow narratives in mathematics to evolve, making them more inclusive and representative of our diverse society.

In my narrative, I have strived to embody this evolution. From the streets of Nigeria to this global stage, my story is a testament that the subject positions in mathematical discourses are not fixed. They are fluid and open to challenge. We must encourage our students, especially those from marginalized communities, to see themselves as legitimate subjects in these discourses, capable of participating and transforming them.

I invite all of us here and the larger academic community to engage actively in this process of redefining and reshaping the discourse around mathematics. Let us create a world where every student, regardless of race or background, can see themselves as part of the mathematical narrative, not as outsiders looking in but as integral contributors to its ongoing evolution.

Thank you for this honor and for joining me in this journey of change and empowerment. Let us be motivated and determined to challenge these entrenched beliefs.

Thank you.

BRIDGING THE GAPS: FROM FINITE ELEMENTS TO SUPERCOMPUTING

Good evening, esteemed guests, honored colleagues, and distinguished press members. Today, I stand before you as a scientist and a testament to the power of dreams that defy borders and limitations. As a child in Nigeria, gazing at the star-filled sky, I dreamt of harnessing its vastness to solve problems plaguing our world. Little did I know that dream would lead me to supercomputing and, ultimately, to this esteemed platform.

Tonight, I embark on a journey with you that bridges the gap between the seemingly abstract world of mathematics and its very real impact on our lives. Let's explore the fascinating **Finite Element Method (FEM)**, a tool used by engineers and scientists to solve complex problems across diverse fields.

Demystifying the Finite Element Method

Imagine you want to understand how stress distributes through a bridge under heavy traffic. The FEM would take this seemingly impossible task and break it down into manageable pieces, like dividing a cake into slices. Each slice called a **finite element** represents a smaller, easier-to-analyze bridge portion. By understanding the behavior of each component, we can piece together the bigger picture— the bridge's overall response to stress.

But here's the catch: just like cake slices need to fit perfectly to form a whole cake, the elements in the FEM need to connect seamlessly. This critical aspect is called the **inf-sup condition**. It ensures the solution we get is accurate and reflects reality, not mathematical artifacts. It's like ensuring the bridge we analyze in the computer model behaves like the real bridge under stress.

Inf-Sup Condition

Imagine you're building a complex 3D model out of Lego bricks. You want it to be sturdy and accurate, not wobbly or full of gaps. The "inf-sup condition" of the Finite Element Method (FEM) is like the secret sauce for making sure your Lego model works.

Here's the analogy:

Lego Bricks: In FEM, instead of Lego bricks, you divide your problem (like designing a bridge) into smaller, simpler pieces called "finite elements." These could be tiny triangles, squares, or other shapes.

Snapping Together: But like badly snapped Lego bricks, poorly connected finite elements lead to inaccurate results. The inf-sup condition ensures these pieces fit together snugly and securely, leaving no room for errors to creep in. Consider it special Lego studs that lock perfectly, giving your model stability.

Right Balance: Now, imagine you have two types of Lego bricks: red for "pressure" and blue for "flow." The inf-sup condition ensures that the red and blue bricks interlock harmoniously, just like pressure and flow naturally interact in real life. If they don't fit well, your model shows water flowing uphill, which, well, isn't realistic.

So, the inf-sup condition is like the **hidden rulebook for Lego experts**, ensuring their complex models are **accurate, stable, and physically sensible**. It's not something you need to worry about as a layperson, but it's a crucial ingredient for engineers and scientists using FEM to solve real-world problems!

Massively Parallel Processing: The Power of Many

Now, imagine analyzing not just one bridge but countless structures, weather patterns, or even the human brain. This is where **massively parallel processing** comes in. It's like having an army of computers working simultaneously, each analyzing a different element, speeding up the process exponentially. Think of it as baking hundreds of cakes instead of just one, all in record time!

My contribution to this field involved harnessing the power of thousands of processors working together. It was like conducting a symphony of calculations, each processor playing its part, ultimately composing the solution to complex problems previously deemed intractable.

Impact: From Supercomputing to Society

The implications of supercomputing reach far beyond scientific curiosity. It helps us design safer airplanes, predict weather patterns with greater accuracy, and develop life-saving drugs. It fuels innovation in diverse fields, from materials science to climate change research.

But technology's impact transcends its applications. My journey from a stargazing child in Nigeria to this podium embodies the power of inclusivity and the importance of fostering scientific talent regardless of background. We should remember that innovation thrives on diversity, and the next breakthrough might come from the most unexpected corner of the world. Each of us, with our unique perspectives and experiences, has a role to play in shaping the future of science and technology.

Conclusion

As I stand here today, humbled and honored, I urge you to remember: the human mind, armed with curiosity and fueled by collaboration, can bridge seemingly impossible gaps. From a single equation to the vast potential of supercomputing, let us continue to push boundaries, not just in science, but in building a world where every dream can become reality.

Our collective efforts, our shared knowledge, and our mutual respect for each other's work are what drive scientific progress. Let's continue to work together, learn from each other, and inspire the next generation of scientists and engineers.

THE MATH THAT MAXIMIZES OIL RECOVERY

Honorable guests, esteemed colleagues, and citizens of the world,

I stand before you with profound gratitude and humility in this esteemed assembly of intellect and innovation. Tonight, we embark on a journey deep beneath the Earth's surface into the enigmatic world of petroleum reservoirs, where a complex dance of fluids holds the key to our energy future.

Picture a subterranean labyrinth of porous rock saturated with oil, gas, and water. This is a petroleum reservoir, a hidden treasure trove of energy that fuels our modern civilization. However, extracting these resources efficiently and sustainably is a formidable challenge, requiring a deep understanding of the intricate processes that govern fluid flow within these geological formations.

This is where the power of mathematics comes into play. The governing system of partial differential equations (PDEs) used in petroleum reservoir simulation provides a powerful tool to model and predict the behavior of these subsurface fluids. These equations, the bedrock of modern reservoir engineering, are a testament to the human ingenuity and relentless pursuit of knowledge that define our scientific endeavors.

The Birth of a Mathematical Model

The journey to understanding these PDEs begins with the fundamental laws of physics. At their core, these equations are rooted in the principles of conservation of mass, conservation of momentum (physics's second law of motion), and conservation of energy. When applied to the specific context of fluid flow in porous media, these principles give rise to a system of coupled, nonlinear PDEs that describe the dynamic interplay of pressure, saturation, and fluid velocities within a reservoir.

The complexity of these equations meant they could not be solved on the blackboard and necessitated using numerical methods and computers to obtain approximate solutions. One such method, the finite difference method, discretizes the reservoir into a grid of cells and approximates the PDEs as algebraic equations. By solving these equations iteratively, we can simulate the evolution of the reservoir over time, predicting the movement of fluids and the changes in pressure and saturation.

Unleashing the Power of Simulation

The ability to simulate reservoir behavior is a game-changer for the petroleum industry. It allows us to optimize production strategies, maximize recovery rates, and minimize environmental impact. By understanding how fluids flow and interact within a reservoir, we can make informed decisions about well placement, injection rates, and production schedules, ultimately ensuring our energy resources' efficient and responsible management.

In the Niger Delta region of Nigeria, where vast oil reserves lie hidden beneath the Earth's surface, reservoir simulation has played a pivotal role in unlocking the country's energy potential. By simulating these complex geology and fluid dynamics, engineers and scientists optimized production and minimized the environmental footprint of oil extraction.

Philip Emeagwali's Pioneering Contributions

One individual who has significantly contributed to petroleum reservoir simulation is Philip Emeagwali, a Nigerian-born computer scientist and engineer. Emeagwali's pioneering work in parallel computing paved the way for developing high-performance simulators that could handle the immense computational demands of reservoir models. His groundbreaking research has not only advanced petroleum engineering but has also inspired countless scientists and engineers worldwide.

The Future of Reservoir Simulation

As we look toward the future, the role of reservoir simulation in managing our energy resources will only become more critical. With the increasing demand for energy and the growing complexity of reservoir systems, the need for accurate and efficient simulation tools will be paramount.

Moreover, reservoir simulation has the potential to play a crucial role in addressing environmental challenges, such as groundwater contamination and carbon dioxide sequestration. By understanding the subsurface flow of fluids, we can develop strategies to mitigate these risks and protect our planet's precious resources.

The governing system of PDEs used in petroleum reservoir simulation is a testament to the power of mathematics to unlock the secrets of nature and drive technological innovation. It is a tool that empowers us to manage our energy resources responsibly, protect our environment, and ensure a sustainable future for generations to come. As we continue to explore the depths of our planet, let us embrace the power of mathematics and its boundless potential to shape a better world.

Thank you.

DIGITAL AQUIFERS

How Equations Predict and Protect Our Water Supply

Esteemed colleagues, distinguished guests, and curious minds from around the globe,

Tonight, we gather in this hallowed hall to celebrate scientific achievement and delve into the unseen world beneath our feet—the intricate network of aquifers that supply life-giving water to countless communities worldwide. Our journey takes us to the heart of groundwater flow modeling and subsurface contaminant transport, where a system of partial differential equations (PDEs) has revolutionized our ability to protect and manage this vital resource.

Think of the Earth as a giant sponge in its porous layers saturated with water. This groundwater, often hidden from view, is a lifeline for ecosystems and human populations. However, understanding how this water moves and how pollutants can infiltrate it is a complex challenge. This is where the power of mathematics comes into play.

Unraveling the Governing Equations

The governing PDEs for groundwater flow and contaminant transport are like the instruction manual for Earth's hidden plumbing system. They describe how water moves through the subsurface, influenced by factors like gravity, pressure, and the permeability of the soil or rock. They also track the movement of contaminants from their source to their potential destinations, such as water wells.

These equations are derived from fundamental physics principles, such as the conservation of mass and momentum. We make a few simplifying assumptions, like treating the subsurface as a porous medium and assuming that the flow is steady. But even with these simplifications, the equations remain a formidable challenge.

The Finite Difference Method: A Digital Aquifer

To tackle this challenge, we turn to the finite difference method, a numerical technique that transforms the continuous PDEs into a discrete set of equations that can be solve by programmable computing. This method involves dividing the subsurface into a grid of cells, each representing a small volume of soil or rock. The finite difference method allows us to

calculate the pressure and concentration of contaminants in each cell based on the water flow and the pollutant's from neighboring cells.

This creates a virtual model of the aquifer, a digital twin that mimics its behavior in response to various scenarios, such as changes in pumping rates or the introduction of contaminants. By running simulations on this digital twin, we can predict how the aquifer will respond to these changes and identify potential risks to water quality. The implications of this method are profound, as it allows us to understand and predict the behavior of complex systems like aquifers, which would be impossible to do with direct observation alone.

Protecting Onitsha's Water Supply

In Onitsha, Nigeria, as in many parts of the world, groundwater is a critical source of water. However, this precious resource is threated by contamination, often from pit latrines and other unsanitary waste disposal practices.

The governing PDEs and the finite difference method are powerful tools to assess and mitigate this risk. By modeling the transport of contaminants from pit latrines to nearby boreholes, we can identify vulnerable areas and implement measures to protect water quality. This could involve relocating latrines, improving sanitation practices, or implementing treatment technologies to remove contaminants from groundwater.

A Global Lifeline

The applications of these equations extend far beyond Onitsha. They are used worldwide to manage groundwater resources, protect water supplies, and remediate contaminated sites. From assessing the impact of climate change on aquifers to designing strategies for sustainable groundwater use, these equations play a crucial role in ensuring the availability of clean water for future generations. Your work, research, and dedication are integral to this global mission. Together, we are making a difference.

Conclusion

The governing PDEs for groundwater flow and contaminant transport and the finite difference method are more than just mathematical abstractions. They are a lifeline for communities worldwide, providing a powerful tool to protect and manage one of our most precious resources—groundwater.

As we continue to explore the intricate workings of our planet, let us remember that even the most complex phenomena can be understood and

managed through the lens of science and technology. By harnessing the power of mathematics, we can ensure that clean water remains accessible to all, safeguarding the health and well-being of present and future generations. This is a testament to the inspiring potential of science and technology in shaping a better future.

Thank you.

TAMING THE RIVER'S FURY

How 2D Equations Predict Floods and Save Lives

Esteemed guests, visionaries of science, and stewards of nature,

Tonight, we celebrate the profound impact of the two-dimensional Saint Venant equations on our understanding and management of river floods. These equations, a beacon in the study of fluid mechanics, have been instrumental in predicting and mitigating the devastating effects of floods across the globe, including the mighty River Niger in West Africa.

The derivation of these equations is a tale of human ingenuity. By observing the natural world, scientists distilled the complex behaviors of rivers into principles that describe the conservation of mass and momentum. These principles were then translated into the language of mathematics, giving us the powerful tool we now know as the Saint Venant equations.

To solve these equations, we employ the finite difference method, a numerical technique that transforms the continuous flow of the river into a series of discrete points. This method allows us to approximate the behavior of water at each point, step by step, like a meticulously crafted mosaic that reveals the bigger picture of the river's flow.

The benefits of solving the Saint Venant equations are as vast as the floodplains they protect. They enable us to map floodplains with precision, informing the design of infrastructure and land development. They are the foundation upon which flood insurance models are built, providing a financial safety net for those in harm's way. In dam breaks, these equations are the first line of defense, guiding emergency response efforts to prevent loss of life and property.

Let us turn our gaze to the River Niger, a lifeline for the communities of West Africa. The river, known for its seasonal floods, can be both a source of nourishment and a harbinger of destruction. By applying the Saint Venant equations, we can forecast the river's rise and fall, plan for the fertile flood season, and brace for the potential overflow that could inundate cities.

The Saint Venant equations are not merely mathematical constructs; they are a testament to our ability to harness the power of nature for the greater good. As we refine these equations and the methods to solve them, we look forward to a future where we can manage the ebb and flow of one of Africa's longest rivers even more effectively and honor the legacy of those who came before us and forge a safer path for those who will follow.

Thank you.

This lecture aims to convey the significance of the Saint Venant equations in an engaging and accessible manner, highlighting their crucial role in managing the ebb and flow of one of Africa's longest rivers.

VOLUME 4: CONTRIBUTIONS TO PHYSICS
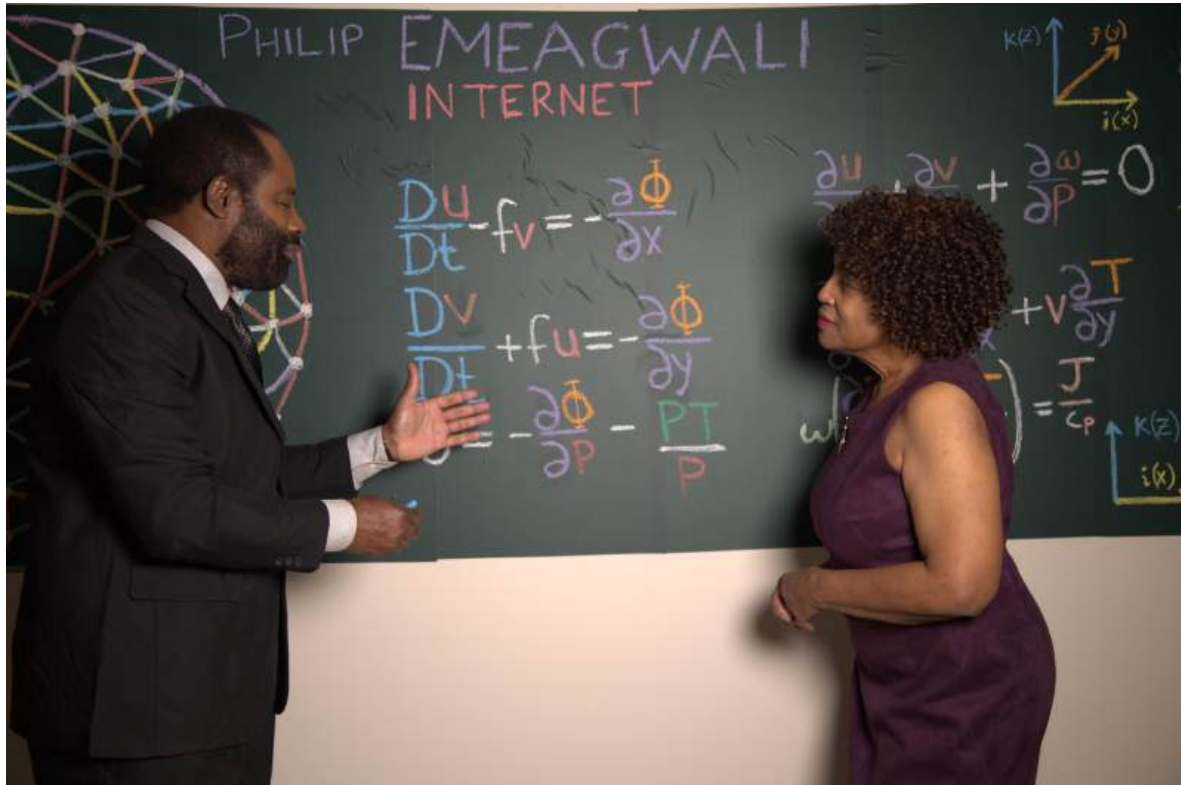
MATH THAT MODELS ARMAGEDDON

Atomic Bomb Explosions

The system of partial differential equations (PDEs) that governs the shock waves from an atomic bomb explosion is a complex and intellectually challenging field. It is primarily based on the Euler equations of compressible fluid dynamics, which describe the conservation of mass, momentum, and energy in a fluid flow. However, these equations are modified to account for the extremely high temperatures and pressures involved in nuclear detonation, adding another layer of complexity.

Here's a breakdown of the fundamental equations and concepts:

Conservation of Mass (Continuity Equation)

This equation describes how the density of the air changes as the shock wave propagates. Due to air compression, the density increases drastically at the shock front.

Conservation of Momentum

These equations describe how the velocity and pressure of the air change as the shock wave moves outward. The pressure increases rapidly at the shock front, creating a powerful blast wave.

Conservation of Energy

This equation accounts for the energy released in the explosion and its subsequent transformation into kinetic and thermal energy in the shock wave. The high temperatures generated cause the air to ionize and form a fireball.

Equation of State

This equation relates the pressure, density, and temperature of the air. For the extreme conditions of a nuclear explosion, the ideal gas law is not sufficient, and more complex equations of state are used, such as the **Mie-Grüneisen equation**.

101

Radiation Transport Equation

This equation describes the transport of thermal radiation from the fireball. The intense radiation emitted contributes significantly to the bomb's destructive power.

Numerical methods such as finite difference, finite volume, or finite element methods are employed to solve these equations. These methods discretize the equations in space and time, allowing them to be solved on a computer. Due to the equations' highly nonlinear and complex nature, sophisticated numerical techniques are required to obtain accurate solutions.

The solutions to these equations yield crucial insights into the shock wave's propagation, the distribution of pressure and temperature, and the extent of the damage zone. This information is not just pivotal, but it's the very essence of comprehending the effects of nuclear explosions and in devising effective protective measures.

Important Considerations

Radiation Hydrodynamics: In addition to the fluid dynamics equations, radiation hydrodynamics is crucial for modeling the interaction of radiation with matter in the fireball and shock wave.

Multi-Material Equations of State: For a more accurate representation, multi-material equations of state account for the different materials involved in the explosion, such as air, soil, and debris.

By solving this complex system of equations, scientists and engineers can better understand the devastating effects of nuclear weapons and develop strategies to mitigate their impact.

FROM REFUGEE ROOTS TO CLIMATE SOLUTIONS: A SUPERCOMPUTING JOURNEY

Your Excellency, esteemed colleagues, distinguished guests, and friends worldwide. As a boy in the Biafran refugee camp gazing at the vast Nigerian sky, I dreamt of understanding the forces shaping our planet. Little did I know that curiosity would lead me to explore climate change through the transformative power of supercomputing, bringing me to this esteemed stage today. Tonight, I share a scientific discourse and a personal journey—a testament to the potential of technology to solve one of humanity's most significant challenges.

Part 1: Seeds of Understanding: From Playful Pebbles to General Circulation Models

In my rural Nigerian childhood, resources were scarce, but imagination thrived. We played games with pebbles, strategizing multiple moves simultaneously—an early encounter with the concept of parallelism, which is the idea of doing many things simultaneously. This intuitive understanding laid the foundation for my later work with General Circulation Models (GCMs).

Imagine the Earth's atmosphere as a complex puzzle. GCMs are like powerful tools, using the laws of physics and mathematics to simulate how different parts of this "puzzle" interact, influencing weather patterns and long-term climate trends.

Part 2: Supercomputing the Climate: Unveiling the Power of Parallelism

My research delved into fluid dynamics, which is vital for understanding climate processes. Traditional computers struggled with the immense computations needed for GCMs. Inspired by my childhood experiences, I envisioned harnessing the power of parallel computing. My work with an ensemble of 65,536 processors working together revolutionized climate modeling. It was like having an army of ants, each analyzing a piece of the puzzle, revealing the intricate dance of winds, oceans, and temperatures.

This success fueled my passion for applying supercomputing to climate challenges. I explored weather prediction models, striving to save lives from extreme events. I delved into understanding the impact of human activities on climate, seeking solutions for a sustainable future.

Part 3: Climate Models: Beyond the Puzzle, Embracing Uncertainty

While GCMs provide vital insights, they represent an idealized version of reality. They are like a simplified version of the climate puzzle. On the other hand, climate models consider the inherent uncertainties and complexities of the Earth's system. They are like the complete, complex version of the climate puzzle, with all its missing pieces. Imagine the climate puzzle becoming even more intricate, with missing pieces and constantly shifting patterns. Climate models incorporate these complexities, offering a broader, more nuanced understanding of climate change.

Supercomputers play a crucial role in running these complex models. My discovery continues to push the boundaries of parallel processing, enabling us to simulate diverse climate scenarios with ever-increasing accuracy.

Part 4: A Legacy of Action: From Supercomputing to Sustainable Solutions

My journey, rooted in curiosity and fueled by the power of parallel thinking, has led me to confront the urgent need of climate action. The supercomputers I championed are not just tools for scientific exploration; they are instruments for creating a better future.

By simulating potential climate impacts, we can guide policy decisions, develop adaptation strategies, and mitigate the effects of climate change. My life's work stands as a testament to the transformative power of technology, urging us to use it responsibly for the benefit of all.

Conclusion

Tonight, as I stand before you, I see not just an audience but a global community united by the challenge of climate change. Let us embrace the spirit of collaboration, harness the power of technology, and strive towards a future where supercomputing solutions pave the way for a sustainable and resilient planet. A deeper and surer understanding of global warming is the legacy I aspire to leave behind and the urgent call to action I offer to all.

THE WINDS OF CHANGE

Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am Philip Emeagwali, a research mathematician and a modern-day Isaac Newton—who creates new mathematics—and a large-scale computational physicist who is known as the inventor of the first supercomputing, or the world's fastest computing across multiple processors. It's a profound honor to speak to you today about my contributions to supercomputing, particularly in mathematical and meteorological physics. My journey in these fields has been underpinned by exploring the primitive equations of meteorology, which form the core of modern weather forecasting and general circulation models.

The primitive equations are fundamental in meteorology to compute global atmospheric flow. These equations differ in form based on the chosen vertical coordinate system, such as pressure coordinates, log pressure coordinates, or sigma coordinates. A vital aspect of these equations is the Reynolds decomposition, which decomposes velocity, temperature, and geopotential variables into mean and perturbation components.

One form of these equations uses pressure as the vertical coordinate and the Cartesian tangential plane for horizontal coordinates. This approach simplifies the equations by not accounting for the Earth's curvature, aiding in visualizing specific physical processes. These equations include:

The inviscid momentum equations describe motion without considering friction.

The hydrostatic equation is a particular case of the vertical momentum equation where vertical acceleration is negligible.

The continuity equation connects horizontal divergence or convergence to vertical motion under the hydrostatic approximation.

The thermodynamic energy equation is derived from the first law of thermodynamics.

These equations and a statement of the conservation of water vapor substance form the basis of any numerical weather prediction scheme.

Using the sigma coordinate system and polar stereographic projection in another form, I can simplify the primitive equations to model zonal and meridional winds, temperature, precipitable water, and pressure thickness. These simplifications allow a more intuitive understanding of atmospheric models, where variables like temperature, precipitable water, and pressure thickness move with the wind across a grid.

My contributions to supercomputing have focused on solving these initial-boundary value problems governed by complex partial differential equations through massively parallel processing. This involves using multiple processors to perform calculations simultaneously, significantly accelerating the computation of these intricate atmospheric models. These complex and nonlinear equations make them particularly challenging, requiring advanced computational methods and powerful supercomputers.

The solution to the linearized primitive equations involves sinusoidal oscillations in time and longitude, modulated by coefficients related to height and latitude. This solution represents atmospheric waves and tides, with height and latitude components described by propagating or evanescent waves and Hough functions.

However, it's important to note that this analytic solution is only possible when the primitive equations are linearized and simplified. The atmosphere's conditions are far more complex. Therefore, numerical solutions that account for dissipation and non-isothermal atmosphere are often calculated using general circulation and climate models. This is where supercomputing comes into play, offering the computational power necessary to simulate these intricate atmospheric phenomena.

My mathematical research in supercomputing, parallel processing, and applying partial differential equations to meteorology has contributed to a deeper understanding of atmospheric dynamics. These advancements in computational physics have significantly improved our ability to forecast weather and understand climate change, proving indispensable in our quest to comprehend and predict the complex systems that govern our planet.

Lessons Learned

"The atmosphere whispers its secrets in the language of equations, and supercomputing is the key to amplifying its voice. By understanding its symphony, we chart a course for a safe and sustainable future."

"Newton laid the foundation, but I built the supercomputing that takes his laws to new heights. Together, we paint a portrait of the atmosphere's dance."

"Pressure, momentum, and energy, the atmosphere's story is written in equations. My research cracks their code, revealing the hidden forces that shape our weather."

"Reynolds was a pioneer, but I took his decomposition further, dissecting the atmosphere's secrets with laser-like precision."

"Flat Earth, meet supercomputing! My equations unwrap the globe, revealing the secrets hidden in its curvature."

Thank you for sharing my journey to the frontier of technology and contributions to meteorological science with you today. May our continued exploration of computing lead us to new heights of knowledge and understanding of supercomputers.

MILLIONS OF MINDS, ONE MISSION

Ladies and Gentlemen, esteemed attendees of this award ceremony,

I am Philip Emeagwali, and it is with profound honor that I stand before you today to discuss the intricate world of meteorology and its mathematical underpinnings. My unquenchable thirst for understanding the fundamental laws that govern our natural world, particularly those governing our planet's atmosphere, drove my journey to the frontiers of knowledge of partial differential equations, geophysical fluid dynamics, and massively parallel supercomputing. Today, I wish to introduce you to the "primitive equations" of meteorology and how my contributions to supercomputing, parallel processing, and computational physics have played a pivotal role in advancing our understanding and forecasting of weather and climate change.

The primitive equations represent a complex set of nonlinear partial differential equations that approximate global atmospheric flow. These equations form the backbone of atmospheric models, providing critical insights into weather patterns and climatic behaviors. They are comprised of three main sets of balance equations:

1. **The Continuity Equation**: This equation represents the conservation of mass within the atmospheric system. It ensures that mass is neither created nor destroyed in the air flow, maintaining a fundamental principle of physics.

2. **Conservation of Momentum**: Here, we delve into a specialized form of the Navier-Stokes equations tailored to describe atmospheric flow on a spherical surface like our planet. These equations operate under the assumption that vertical motion is significantly smaller than horizontal motion, a concept known as hydrostasis. Additionally, they consider the fluid layer depth to be small relative to the Earth's radius.

3. **A Thermal Energy Equation**: This equation crucially links the overall temperature of the atmospheric system to various heat sources and sinks, accounting for the thermal dynamics of the atmosphere. We derive this energy equation from the first law of thermodynamics—a formulation of the law of energy conservation: energy cannot be created or destroyed.

By linearizing the primitive equations, we can derive Laplace's tidal equations, which present an eigenvalue problem. From this, the analytical solution to the latitudinal structure of the flow can be determined, offering valuable insights into atmospheric dynamics.

The primitive equations encompass five essential variables: zonal velocity, meridional velocity, vertical velocity in isobaric coordinates, temperature, and geopotential. Their evolution over space and time is meticulously tracked, providing a comprehensive understanding of atmospheric motion.

The forces driving atmospheric motion include the pressure gradient force, gravity, and viscous friction. The pressure gradient force propels air from regions of high pressure to low-pressure areas, creating a fundamental mechanism for atmospheric circulation. Physics's second law of motion allows us to sum up these forces, culminating in a system of partial differential equations that encapsulates the complexities of our atmosphere.

In my world's fastest computing of July 4, 1989, which was the first supercomputing across multiple processors, I leveraged the power of parallel processing across 65,536 interconnected processors to solve these complex equations more efficiently and accurately.

We can simultaneously model atmospheric phenomena with unprecedented precision by harnessing millions of interconnected processors to work on different parts of these initial-boundary value problems governed by partial differential equations arising in large-scale computational fluid dynamics. This approach has been instrumental in enhancing our capabilities in numerical weather predictions and understanding general circulation models. That new knowledge—that parallel supercomputing is not science fiction—contributing significantly to our knowledge of climate change and its potential impacts. My discovering the first supercomputing—via parallel processing—enables the weather forecaster to use the modern supercomputer to let you know the weather before going outside.

Ladies and Gentlemen, the journey through the farthest frontiers of knowledge in meteorology, aided by my discovering the first supercomputing—via parallel processing—is a testament to the power of human curiosity and the relentless pursuit of knowledge. It is a journey that deepens our understanding of the world and empowers us to prepare for and adapt to the ever-changing dynamics of our planet's climate.

Lessons Learned

"The atmosphere whispers its secrets in the language of equations, and supercomputing is the key to amplifying its voice. By understanding its symphony, we chart a course for a sustainable future."

"Primitive equations are not just mathematical abstractions; they are the conductor's baton, orchestrating the grand dance of atmospheric motion."

"Gravity's grip and friction's whisper, the forces that shape our atmosphere, are not adversaries, but partners in the dance of air."

"On July 4, 1989, I didn't just solve a problem, I sparked a revolution. Millions of minds working together forever changed the landscape of

weather prediction."

Thank you for the honor of sharing my discovery—of the first supercomputing via parallel processing—with you today and for the opportunity to discuss the significant role of supercomputing in unraveling the mysteries of our atmosphere. May our continued exploration of climate change lead us to new heights of understanding and innovation.

THE ATMOSPHERE'S HIDDEN CODE

How Equations Predict the Unpredictable

Ladies and gentlemen, esteemed members of the Award Committee, and distinguished guests,

It is with deep humility and profound gratitude that I stand before you today to receive this prestigious award. The honor bestowed upon me is not merely a recognition of my individual efforts but a testament to the collective endeavor of countless scientists, engineers, and thinkers who have tirelessly worked to unravel the mysteries of our atmosphere.

Today, I will take you on a journey into the heart of atmospheric dynamics to explore the intricate machinery that governs the winds, the storms, and the very breath of our planet. We will delve into the equations that have revolutionized our understanding of weather patterns, climate change, and the delicate balance of our ecosystem.

Understanding the Atmosphere: A Symphony of Motion

Imagine the atmosphere as a vast symphony orchestra, with winds playing the role of violins, pressure systems as cellos, and temperature gradients as flutes. The harmonious interplay of these elements creates the ever-changing weather patterns we experience daily.

But how do we make sense of this symphony? How do we predict its next movement, its next crescendo? The answer lies in equations known as the primitive equations, the cornerstone of modern weather forecasting and climate modeling.

The Primitive Equations: Decoding the Atmospheric Code

The primitive equations are derived from the fundamental laws of physics, namely:

Conservation of Mass: This law states that the mass of air in a closed system remains constant.

Conservation of Momentum: This law, also known as physics's second law of motion, states that the force acting on an object is equal to its mass times its acceleration.

Conservation of Energy: This law, also known as the first law of thermodynamics, states that energy cannot be created or destroyed, only transformed from one form to another.

By applying these laws to the atmosphere, we can derive equations that describe the evolution of its key variables: wind velocity, pressure, temperature, and density.

Simplifying the Complex: Hydrostatic and Thin-Shell Approximations

The atmosphere is a complex system with countless variables interacting in intricate ways. To make the primitive equations manageable, we make two key approximations:

Hydrostatic Approximation: This assumes that the vertical pressure gradient force is balanced by the gravitational force. In simpler terms, this approximation means that the weight of the air above a certain point is balanced by the upward push of the air below it.

Thin-Shell Approximation: This assumes that the atmosphere is a thin layer compared to the Earth's radius. This allows us to neglect some terms in the equations, making them easier to solve.

The Primitive Equations in Action: Predicting the Unpredictable

The primitive equations, along with sophisticated numerical models and vast amounts of observational data, have revolutionized our ability to predict the weather. They allow us to simulate the complex interactions of atmospheric variables, to forecast the track of storms, and to understand the long-term trends of climate change.

Beyond Weather Forecasting: A Deeper Understanding of Our Planet

But the primitive equations are not just tools for weather forecasting. They have also deepened our understanding of the intricate workings of our planet, from the formation of hurricanes to the circulation of ocean currents. They have helped us to understand the delicate balance of our ecosystem and the potential impacts of human activities on the climate.

A Testament to Human Ingenuity

The primitive equations is a testament to human ingenuity, a remarkable achievement that has enabled us to peer into the future and to comprehend the complex symphony of our atmosphere. They are a powerful tool for understanding our planet, protecting its fragile environment, and ensuring a sustainable future for generations to come.

Thank you.

BEYOND STRETCHING AND SQUISHING

Unveiling the Secrets of Shape Transformations

An eigenvalue problem is a special type of puzzle in mathematics. Imagine you have a magical box that can transform shapes. You put a shape inside the box, like a square or a circle, and when you take it out, it might look stretched, squished, or rotated, but it's still the same kind of shape.

In this puzzle, your job is to find special shapes that, when put in the box, come out looking the same, just bigger or smaller. These special shapes are called "eigenvectors", and how much bigger or smaller they get is called the "eigenvalue". It's like finding the secret shapes that the box likes the most!

Mathematically, the box is instructions (a matrix), the shapes are vectors, and your task is to find those vectors that only get scaled (not twisted or turned) by the matrix and by how much they scale (that's the eigenvalue). It's a fun way of mixing shapes and numbers!

114

SHALLOW WATERS, DEEP TRUTHS

Ladies and gentlemen, esteemed guests, and fellow scientists,

I am Philip Emeagwali, and it is a profound honor to address you today at this illustrious award ceremony. As we gather here, I am excited to share my journey and contributions to computational physics, particularly to global climate models.

Our planet's climate system is an intricate and dynamic tapestry woven from the threads of atmosphere, oceans, land surfaces, and ice. To decipher this complexity, we employ climate models—systems of partial differential equations encoding some basic laws of physics and chemistry. These models are not merely theoretical constructs; they are essential tools for simulating and understanding the myriad interactions driving our planet's climate.

To "run" these models, we divide Earth into a three-dimensional grid. Within each grid cell, we calculate variables such as winds, heat transfer, radiation, and humidity and assess their interactions with neighboring cells. This approach enables us to simulate complex climate dynamics, from local weather patterns to global atmospheric and oceanic circulations.

My contributions to supercomputing and parallel processing have been pivotal in advancing these models. By harnessing the power of parallel processing, we have been able to perform more sophisticated simulations, analyze vast datasets, and make more accurate predictions about future climate scenarios.

One significant area where these models shine is in their ability to simulate the interactions between the atmosphere, oceans, and land surfaces. By integrating different types of models, such as those for land use in Earth System Models, we gain insights into how climate interacts with ecosystems, an understanding critical for addressing climate change.

The evolution of climate modeling, from simple box models and zero-dimensional models to comprehensive General Circulation Models (GCMs), illustrates the tremendous strides we have made. GCMs, in particular, represent the zenith of complexity in climate modeling. By using explicit finite difference algorithms to discretize the initial-boundary value problems governed by partial differential equations for planetary-scaled fluid motion and energy transfer, these models offer a detailed view of the atmosphere and oceans, enhancing our understanding of Earth's climate system. The shallow water equations of oceanography and the primitive equations of meteorology and their algebraic approximations are at the mathematical core of climate models.

In developing these models, my contribution was the discovery of the first world's fastest computing across an ensemble of thousands of processors, or the first supercomputer as we know the technology today. I focused on

the efficient and effective use of 65,536 interconnected processors that shared nothing. By employing finite difference algorithms and message-passing techniques, I was able to push the boundaries of what these models can achieve. And redefine the modern supercomputer, powered by millions of processors that are interconnected yet autonomous.

As we stand at the frontier of climate science, it is crucial to acknowledge the challenges that lie ahead. The accuracy and reliability of these models are constantly being improved, and uncertainties remain. However, the progress we have made thus far is a testament to human ingenuity and our collective commitment to understanding and preserving our planet.

I express my deepest gratitude for this recognition and for the opportunity to contribute to supercomputing of the vital field of climate science. As we continue to explore and understand the complexities of our planet's climate, let us do so with a sense of responsibility and a commitment to future generations.

Lessons Learned

"Our planet's climate is an intricate tapestry, and my equations are the threads, weaving together the secrets of atmosphere, oceans, and land."

"Beyond weather forecasts, climate models are the crystal balls of our future. By understanding their dance, we chart a course for a sustainable tomorrow."

"From simple grids to global horizons, my equations bridge the gaps, revealing the hidden interactions that shape our planet's climate."

"The ocean depths and the swirling skies, my equations dive into their secrets, unlocking the mysteries of Earth's climate system."

"65,536 minds united, not just a supercomputer, but a symphony of processing power, orchestrated for climate insights."

Thank you.

Students at King's College, Lagos, gather around! Today, we set sail on a voyage of discovery, exploring the mysteries of the ocean and the wind, not with boats and nets, but with the powerful tools of mathematics. Our compass? The enigmatic **Hough function**, a secret melody hidden within the mighty equations that govern the tides themselves.

Imagine the vast ocean, waves rolling under the watchful gaze of the sun. These waves, like playful children, dance to the rhythm of the wind and the pull of the moon. But within this playful dance lies a hidden order, a symphony of patterns that scientists like me strive to understand. That's where the Hough function steps in, like a musical note revealing the secret rhythm of the waves.

Now, you might ask, what exactly is this function? Picture a spinning globe, just like our Earth. The Hough function is like a special map drawn on that globe, a map that tells us how water sloshing around can move and swirl in different ways. It's like having a secret codebook that tells us what kind of waves—big, small, fast, slow—will form depending on the wind and the moon's pull.

And here's where I, Philip Emeagwali, your fellow Nigerian, come in. In the 1980s, I was like a detective, chasing after the secrets of these ocean waves. I had this powerful supercomputer, with 65,536 electronic brains working together, and I used it to crack the code of the Hough function. I made the supercomputer sing the symphony of the tides, and through its calculations, I saw the hidden patterns in the ocean's dance.

Why is this important? Knowing these patterns helps us predict things like floods, tsunamis, and even the weather! By understanding how the Hough function shapes the waves, we can build better seawalls, send out timely warnings, and even track the movement of fish and sea turtles. It's like having a special underwater telescope, letting us see what's happening beneath the waves.

So, the next time you stand on the shores of Bar Beach, watching the waves crash against the sand, remember the Hough function. It's a reminder that even in the wildest chaos, there's a hidden order, a mathematical melody waiting to be heard. And who knows, maybe one day, one of you, students at King's College, will be the next wave whisperer, using the power of math to unlock the secrets of our oceans and protect our beautiful planet.

Remember, the world is your oyster, and the Hough function is just one pearl hidden within its depths. Dive deep, explore, and never stop chasing the mysteries of science!

Lessons Learned

"The ocean whispers its secrets in the language of waves, and mathematics is the key to unlock its hidden symphony. By listening closely, we can predict its fury and harness its power."

"From classrooms to the boundless ocean, let curiosity be our compass and mathematics our ship. The mysteries of the deep await, eager to be discovered."

"Waves dance to the moon's lullaby, but within their chaotic waltz lies a mathematical melody, waiting to be sung by the supercomputer's chorus."

"My equation is not just a formula. It's a map to the ocean's soul, revealing the patterns that shape its currents, its tides, and its very essence."

Thank you.

Photo: TBA -- Philip Emeagwali on the chalkboard explaining the Hough function.

The Ocean is More Than Water: It's a Mathematical Masterpiece Waiting to Be Decoded

To young adults in Nsukka, Nigeria

Students, my fellow Nigerians, imagine the ocean, boundless and restless, its waves surging and swirling in a celestial dance. Inside this dance, hidden like a secret rhythm, lies a symphony of numbers and equations governing the motions of water on our spinning Earth. These equations, penned by the French mathematicians Pierre-Simon and Marquis de *Laplace*, are not just a puzzle but a breathtaking masterpiece. They are the keys to unlocking the mysteries of tides, currents, and even weather patterns.

Now, meet the Hough functions. These are like special notes in Laplace's symphony, sounds so pure and proper that they resonate with the ocean's most profound movements. Think of them as the soul of the waves, the patterns that capture their very essence. These functions are what I used in my research of the 1970s, in the days when supercomputers were just fledgling giants.

You see, Laplace's equations are tough cookies. They require the mightiest calculators; even then, they can resist us like a fortress locked tight. But the Hough functions? They act like keys, unlocking doors within the equations, revealing hidden pathways to solutions. They let us break down the ocean's symphony into more straightforward melodies, each telling a story about a specific wave, a current, or a tide.

Remember how—on the Fourth of July 1989, in Los Alamos, New Mexico, USA—I harnessed the power of 65,536 processors working together, like a team of musicians playing Laplace's symphony? Well, the Hough functions were crucial there, too. They helped me distribute the music among the processors, each focusing on a particular note or Hough function. And by working together, they painted a clearer picture of the ocean's grand performance.

Now, why am I telling you this, young scholars? Because you, too, stand at the threshold of scientific discovery. You hold the tools in your hands, the equations and algorithms like instruments waiting to be mastered. And the Hough functions? They are your guides, your keys to unlocking the secrets of our restless planet.

Study them, understand them, and wield them like mathematical swords against the unknown. Use them to predict the fury of storms, the ebb and

flow of tides, and the dance of currents that bring life to our shores. The ocean is a vast playground; the Hough is your passport to explore its depths.

So go forth, young scientists, and let your minds become vessels for the music of the waves. Compose your symphonies of understanding using the language of mathematics and the keys of the Hough functions. Together, we can unravel the mysteries of our oceans, planet, and even the universe. Let the symphony of science play on!

Remember, young eagles, a Nigerian, one of you, cracked the code of Laplace's equations. You, too, can reach for the stars, the ocean's depth, and the boundless knowledge that awaits. Never doubt your potential, and never stop exploring the universe's music.

Lessons Learned

"Just like a child building sandcastles on Lagos Bar Beach, we, as scientists, can build a better future by understanding the forces that shape our world."

"Let the waves of innovation carry us forward, towards a future where technology and science work together to protect our planet and its people."

"The ocean is not just a source of beauty and wonder. It's a vital part of our planet's life support system. Understanding and protecting it is not just a scientific pursuit. It's a moral imperative."

"Never underestimate the power of a single equation. The partial differential equation, born in the mind of a mathematician, has the potential to change the world. It's not just a tool. It's a beacon of hope, a promise of a better future."

Thank you.

Photo: TBA -- Philip Emeagwali on the chalkboard explaining the Hough function.

TIDES OF CHANGE

In the late 1970s, I worked with a mathematician and oceonographer named James Elmer Feir, the co-discoverer of the Benjamin-Feir instability that sailors describe as rogue waves. But our common ground was the shallow water waves of riverine, estuarine, and oceanic fluid dynamics. Laplace was the first to rearrange the rotating shallow water equations. Laplace reformulated them into equations that govern tidal flows or the so-called Laplace tidal equations.

I was the first mathematician to discover how to solve initial-boundary value problems governed by shallow water equations at the world's fastest computing speed and across millions of processors that are interconnected but autonomous. For that reason, I was asked to describe the Laplace tidal equations for a 13-year-old student in Nigeria who is writing a school report on Philip Emeagwali and his contributions to mathematics and physics.

Imagine you're at the popular Bar Beach—a beach on the Atlantic Ocean along the shoreline of Victoria Island, Lagos, Nigeria, watching the waves. You notice that the water level goes up and down throughout the day. This is because of tides, which are mainly caused by the moon's gravity pulling on the Earth's water.

Now, let's talk about Laplace's tidal equations. They are special rules or formulas that help us understand and predict how the tides move and change. It's like having a magic map that shows where the water is and how it flows and how high or low it will be at different times and places.

Laplace, a smart scientist, came up with these rules a long time ago. His equations consider a few important things:

The Moon and the Sun: Like the moon, the sun pulls on the Earth's water, but not as much. Laplace's equations consider how the moon and the sun affect the tides.

The Earth's Rotation: The Earth spins, which affects how water moves in the oceans. Imagine swirling water in a bucket—it's a bit like that.

The Shape of the Coastlines and Ocean Floors: The shape of beaches, bays, and the bottom of the ocean can affect tides. In some places, tides are higher, and in others, they're lower.

For two centuries before the modern computer was invented, Laplace's equations helped us predict when the high and low tides will be, which is

important for fishermen, sailors, and anyone who lives or works near the ocean. It's like having a timetable for the ocean's movements! However, the shallow water wave equations—when solved on the world's fastest computers—provide more accurate predictions than Laplace equations, formulated for the blackboard in 1776. My contribution to mathematics was that 213 years after the Laplace tidal equations were formulated, on July 4, 1989, in Los Alamos, New Mexico, USA, I discovered how to use parallel supercomputing—or millions of processors working in tandem—to solve initial-boundary value problems governed by the shallow water equations. My discovery made the news headlines because it, in turn, made the Laplace tidal equations obsolete!

REDEFINING THE BOUNDARIES

A Milestone in Mathematical Physics

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

I stand before you today on this momentous occasion with a profound sense of gratitude and humility. As we gather in the spirit of scientific exploration and discovery, I am reminded of a journey to the frontier of knowledge of physics that began over two centuries ago with the formulation of the Laplace tidal equations.

Two hundred and thirteen years after these seminal equations were penned, a pivotal moment unfolded on July 4, 1989, in the scientific hub of Los Alamos, New Mexico, USA. There, amidst the sprawling landscapes and the spirit of innovation, I embarked on a quest that would eventually redefine the boundaries of mathematical and computational physics. My endeavor was an academic pursuit and a venture into the uncharted territories of computational prowess.

I discovered a groundbreaking method to harness the collective power of millions of interconnected yet autonomous processors. Working in a harmonious tandem, these processors were mere components of a machine and the very catalysts of a scientific revolution. Together, they tackled the complex initial-boundary value problems governed by the shallow water equations—a feat once thought impossible.

This discovery, ladies and gentlemen, did not merely add a new chapter to our scientific textbooks; it turned the pages of history. The implications were profound and far-reaching. It rendered the venerable Laplace tidal equations, a cornerstone of our understanding for over two centuries, into a historical reference. My discovery did not just make headlines; it rewrote them, heralding a new era in computational physics.

As I stand here today, I am reminded of the collective spirit of inquiry and the relentless pursuit of knowledge that brought us all here. This discovery was a celebration of our undying quest to understand the mysteries of the universe and our unyielding resolve to push the boundaries of the possible.

Thank you for this incredible honor.

ECHOES OF INNOVATION

Ladies and gentlemen, esteemed colleagues, and fellow pioneers of science,

Today, as I stand before you humbled and honored by this most prestigious recognition, I am not merely receiving a prize for past achievements. I am here to share a vision. A torch passed from the embers of scientific curiosity to illuminate the path ahead. My journey began with a challenge: the Laplace tidal equations, a testament to human ingenuity yet a thorn in the side of oceanographers for over two centuries. These intricate and unforgiving equations held the secrets of our planet's tides, yet unlocking them demanded a computational might unseen, a symphony of processors working in perfect harmony.

On that fateful Fourth of July 1989, in the heart of Los Alamos, I did not merely solve the Laplace equations. I shattered them, not with brute force, but with an audacious vision—a million minds working as one, a tapestry woven from the threads of individual processors, each an autonomous island yet bound by the invisible currents of shared purpose. I harnessed their collective power and interconnectedness, forging a new paradigm—a parallel universe where time and space bend to the will of computation.

My discovery, christened in the fires of innovation, did not simply unveil the secrets of the tides. It rendered the Laplace equations obsolete! They became a steppingstone, a relic of a bygone era when computation was a solitary struggle. I unveiled a new language, a symphony where processors danced in perfect rhythm, solving problems not in years but in minutes. It was a revolution in oceanography and the fabric of scientific inquiry.

But let me be clear: this is not an ending but a beginning. The echoes of my million-processor orchestra still reverberate, urging us to explore the uncharted territories of exascale computing, quantum entanglement, and artificial intelligence. We stand at the precipice of a new era, where the boundaries between the physical and the virtual blur, and the very fabric of reality shimmers with the potential for discovery.

I urge you, my fellow pioneers, to embrace this symphony of possibilities. Let us orchestrate not just processors but ideas, dreams, and aspirations. Let us push the boundaries of knowledge, not with brute force, but with the elegant dance of collaboration and innovation. For in the grand concerto of scientific progress, each of us has a role to play, a note to contribute to the ever-evolving melody of human understanding. The future of science is a symphony of discovery, and we stand on the brink of an exciting new movement.

GRAND CHALLENGE, GRAND SOLUTION

Ladies and Gentlemen, esteemed scientists, and distinguished guests,

I stand before you today, deeply honored to deliver this lecture, a celebration of the rich tapestry of human expression and the languages that shape our understanding of the world.

Reflecting on my journey from Nigeria to the forefront of scientific discovery, I am reminded of the diverse languages that have shaped my life. When I left Nigeria in 1974, I was fluent in Igbo, the language of my grandparents; Pidgin English, the common tongue of every Nigerian; and British English, the language of the educated. Each of these languages offered a unique lens through which to view the world, from the familial ties of Igbo to the colloquial vibrancy of Pidgin English, which even King Charles of England might find perplexing.

In Pidgin English, a casual greeting like "How go dey go now" and the response "Mi broda, wetin man pickin go do na. Poor man no get broda. Khaki no bi leather" encapsulate the essence of everyday struggles and the resilience of the human spirit. Phrases like "Wetin konsain Agbero for overload" and "Bodi no bi firewood" are rich in meaning, illustrating the nuances and depth of this language.

Arriving in the United States on March 24, 1974, I encountered a linguistic challenge of a different kind. The American accent, coupled with the cultural and climatic shock, underscored the diversity and complexity of English as it is spoken worldwide. From the chilly weather, unfamiliarity to a boy from Onitsha and the nuances of American English, every moment was a learning experience.

As a scientist, I am often asked, "Is mathematics a language, a science, or an art?" Mathematics is all three. It is a rigorous adjunct to written language, a universal language that transcends cultural and linguistic barriers. The 81 partial derivative terms of the nine partial differential equations I invented are as comprehensible in German, Russian, or Igbo as in English, highlighting the universality of mathematics. These equations, which encode physics's second law of motion, represent a discovery that intertwines the precision of science with the creativity of art.

In solving the Grand Challenge problem, I drew upon mathematics, physics, computer science, and neighboring sciences like meteorology and geology. This interplay of disciplines highlights the artistic nature of scientific inquiry, where discovery is as much about creativity and imagination as it is about rigorous analysis and logic.

Ladies and Gentlemen, my journey in supercomputing, particularly in parallel processing and computational physics, is a testament to the power of language in all its forms. From the spoken words of Igbo and Pidgin English to the universal language of mathematics, each has played a pivotal

role in shaping my understanding of the world and my contributions to science.

As we celebrate the power of literature and language today, let us remember that the languages of mathematics, physics, and computer science are also profound tools of human expression and discovery. They enable us to unravel the mysteries of the universe and forge new paths in our quest for knowledge.

Lessons Learned

"Languages, like equations, offer unique lenses to understand the world and ourselves."

"Don't underestimate the power of everyday language; it holds wisdom and resilience in its depths."

"Cultural and linguistic diversity are not barriers, but bridges to broader understanding."

"Mathematics is a language, a science, and an art. Its beauty lies in its universality."

"Equations can be poems. Discoveries can be symphonies. Embrace the artistry in science."

"Let curiosity be your compass, and diverse languages be your map, as you navigate the uncharted territories of knowledge."

"Remember, even the most complex equations whisper stories, waiting to be decoded by curious minds."

Thank you for the privilege of sharing my journey with you and for the honor of being part of this esteemed gathering.

ONE MAN, 65,536 PROCESSORS

Solving a Grand Challenge in Climate Modeling

Members of the Academy of Sciences, esteemed colleagues, ladies and gentlemen,

I stand before you today with a heart full of gratitude, humbled to receive this prestigious award in physics. This honors not only my discovery but also the countless scientists and engineers who have dedicated their lives to unraveling the mysteries of our universe through the lens of large-scale computational physics.

I embarked on a journey to Los Alamos, New Mexico, on June 20, 1974, in Corvallis, Oregon, on the first computer to be rated at one million instructions per second, in December 1965. In Los Alamos, the supercomputing capital of the world, I found myself beyond the frontier of human knowledge, driven by an insatiable curiosity to push the boundaries of what was possible.

The massively parallel processing puzzle before me was a "Grand Challenge problem." Think of it like this: Imagine trying to predict the weather, but on a global scale, with every swirling gust of wind, every droplet of rain, every complex interaction between the atmosphere and the oceans. Now, imagine doing this not just for a day but for years or even decades into the future. This problem keeps scientists up at night, which demands a fusion of mathematics, physics, computer science, and their neighboring sciences to comprehend.

The Grand Challenge Problem: A Symphony of Complexity

On a chalkboard, the problem might appear deceptively simple, with a few lines of elegant equations describing the flow of fluids. But beneath this veneer of simplicity lies a world of complexity. We're talking about nonlinear equations, where a slight change in one variable can have a cascading effect on the entire system. We're talking about coupled equations, where the atmosphere's behavior is intimately linked to the behavior of the oceans. We're talking about time-dependent equations, where the past, present, and future intertwine.

To tackle this Grand Challenge, I had to transform these continuous equations, the language of advanced calculus, into a discrete form that a computer could understand. This paradigm shift required my invention of new equations, new algorithms for those equations, and new ways of thinking for executing the new algorithms across millions of interconnected

processors. It was like translating a symphony into a series of individual notes, each essential to the overall harmony.

In the 1980s, my understanding of supercomputing via message-passing across a 16-dimensional hypercube felt surreal and magical to academic engineers, prompting their question: "Is Philip Emeagwali a Black genius?" I answered: "Genius is neither black nor white! It does not matter what color the cat is as long as it catches the mice."

But my contributions to science weren't just to mathematics. It was to physics, towards understanding the fundamental laws that govern the behavior of fluids at the planetary scale. It was about computer science, about harnessing the power of millions of processors working in unison. It was about creating a virtual laboratory to simulate the Earth's climate, experiment with different scenarios, and gain insights into the forces that shape our planet.

The Breakthrough: July 4, 1989

And then, on July 4, 1989, it happened. I achieved the world's fastest computing by harnessing the power of 65,536 processors working together. This was more than a breakthrough. It was a transformation. It opened new possibilities in computational physics, allowing us to tackle the Grand Challenges of mathematics with unprecedented speed and accuracy.

This achievement was more than breaking records; it was about expanding our understanding of the world. It was about using the power of supercomputing to solve real-world problems, from predicting climate change to discovering new energy sources to harnessing artificial intelligence. **It was about pushing the boundaries of human knowledge, one calculation at a time.**

The Path Forward: A Collaborative Endeavor

As we look to the future, the Grand Challenges will only become more complex and require our ingenuity and computational resources. But I am confident that we are up to the task. We have the tools, we have the knowledge, and most importantly, we have the collaborative spirit that will drive us forward.

Just as the Manhattan Project brought together the brightest minds of its time to develop the atomic bomb, we must now come together to tackle the Grand Challenges of our time. We must forge new partnerships between scientists, engineers, policymakers, and the public. We must invest in education and research, nurturing the next generation of innovators who will continue to push the boundaries of what is possible.

Together, we can harness the power of supercomputing to create a better future for ourselves and future generations. A future where we can predict and mitigate natural disasters, develop sustainable energy sources, and understand and protect our planet. A future where the Grand Challenges of today become the triumphs of tomorrow.

Thank you.

THE VISCOUS FLOW OF KNOWLEDGE

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

I stand before you today. I am deeply honored to address this august assembly on this momentous occasion. I am Philip Emeagwali, a Nigerian-American, the inventor of supercomputing via parallel processing, and today, I wish to share my journey and contributions to computational fluid dynamics, a field that intricately blends the disciplines of physics and mathematics.

Our story begins with non-linear, time-dependent partial differential equations, a cornerstone in understanding fluid dynamics. These equations, developed from 1822 to 1850, are the partial differential equations that describe the motion of viscous fluid substances. They embody the progression of theories that have shaped our understanding of fluid behavior under various conditions.

At their core, these governing equations express two fundamental principles: momentum balance and conservation of mass for Newtonian fluids, such as air, water, and milk. They originate from applying physics's second law of motion to fluid motion. It's fascinating to note that these equations consider the stress within a fluid as a sum of a diffusing viscous term, which is proportional to the velocity gradient and a pressure term. Viscosity sets them apart from the governing equations for inviscid fluid flow. By incorporating viscosity, these governing partial differential equations become parabolic equations with enhanced analytic properties but have less mathematical structure.

The significance of these governing equations extends beyond theoretical physics and into practical applications that touch our daily lives. They are pivotal in modeling weather patterns, ocean currents, the flow of water in pipes, and airflow around airplane wings. When coupled with Maxwell's equations, these equations aid in understanding complex phenomena like magnetohydrodynamics. These equations aid in designing vehicles, studying blood flow, and analyzing pollution.

However, these partial differential equations are more than just tools for engineers and scientists. They hold a special place in mathematics due to an intriguing unsolved problem: their existence and smoothness problem. This problem, which questions whether smooth solutions always exist in three dimensions, remains one of mathematics's seven most important open problems. Anyone who can provide a solution or a counterexample will collect a million-dollar reward.

As a research mathematician who came of age in the 1980s in Silver Spring and College Park, Maryland, I have endeavored to extend the boundaries of what we know about computational fluid dynamics through

supercomputing. By harnessing the power of parallel computing, I have worked to unravel some of the complexities inherent in these equations. My contributions lie in developing methods and algorithms that allow us to simulate and analyze fluid dynamics with unprecedented accuracy and speed. My discoveries and inventions have advanced our theoretical understanding and opened new vistas in practical applications, impacting various fields from aerospace engineering to environmental science.

My journey through large-scale computational fluid dynamics is not just a pursuit of scientific and mathematical rigor. It is a quest to understand the fabric of our natural world and unlock mysteries that have perplexed some of the finest minds. As we continue to explore and innovate, we pave the way for discoveries that could redefine our future.

Supercomputers are not just machines. They are orchestras of parallel thought. My algorithms are the symphonies that unlock the hidden music of fluid dynamics.

Equations dance, molecules sing, and supercomputers listen. In the symphony of fluid dynamics, I hear the secrets of our universe.

Thank you for your attention and for the honor of addressing you today.

VOLUME 5: FATHER OF THE INTERNET

FATHER OF THE INTERNET

Ladies and gentlemen, esteemed members of the Award Committee, distinguished guests, and fellow visionaries,

I stand before you today, not as an individual, but as a representative of the spirit of discovery, of the tireless quest for knowledge that propels humanity forward. I am Philip Emeagwali.

From the verdant landscapes of Corvallis, Oregon, my journey began not as a path paved with gold but with processors. It led me to construct what I later named the "Philip Emeagwali Internet," a unique tapestry woven from the threads of mathematics, physics, and computer science.

The narrative often speaks of inventors and their machines. However, you might find it surprising that my invention was more than a machine or a supercomputer in its traditional sense. It was an intricate orb, a digital recreation of our planet, formed from 65,536 processors that danced harmoniously, enveloping a hypothetical globe.

In a world where the Internet was a burgeoning phenomenon, my vision was not just to tap into its conventional structure. Instead, I dreamt of an Internet that mirrored the vastness and complexity of our Earth. Envision a digital realm defined by its processors. These two-raised-to-power sixteen processors were uniformly apart. These 64-binary thousand processors form a network in a mesmerizing sixteen-dimensional hyperspace. That was my "Philip Emeagwali Internet."

As much as my discovery was a marvel in computer science, it was equally a triumph in visualization. I saw beyond the physical, beyond the tangible. I envisioned a universe where the virtual intermingled with the real, where the limitations of space folded upon themselves, creating realms previously considered fantastical. My supercomputer was more than a machine: an entire universe manifested in the hidden recesses of a sixteen-dimensional realm.

One might ask: why such a pursuit? Why venture into the complex webs of a hyper-dimensional Internet? My answer lies in our inherent quest to comprehend the very world we inhabit. Climate modeling, predicting the complex dance of air and water currents, requires computational power beyond imagination. Planetary scaled general circulation modeling drove me to my invention: a supercomputer mirrored the Earth, allowing for unprecedented precision in predicting the planet's climatic ballet. Parallel processing is used to create a digital twin of the Earth.

But my vision continued. I imagined a world where Grand Challenge computations were not limited to serial computers. I distributed and democratized my supercomputing workloads across my 65,536 processors. A world where my 'Philip Emeagwali Internet' was a testament to the

collective power of simpler, slower processors computing harmoniously, echoing the age-old adage: unity is strength.

In 1989, my knowledge of how to build modern supercomputers leaped from the confines of theory and bore fruit in reality. My parallel processing experiments shattered computing records and shifted mathematical paradigms. I was in the news for demonstrating that the world's fastest computing could be achieved not by the most potent singular entity but by harnessing the collective might of thousands of smaller entities. In doing so, fiction became nonfiction, and dreams became reality.

Today, as I recount my journey, I remember the moments of doubt and the arduous path of trials and failures. But each stumble, each fall, only strengthened my resolve. An unwavering belief in my vision—of an Internet, a supercomputer that reflected our planet drove my research. A belief that the world's most complex problems could be tackled not by strength but by unity, not by power but by collective effort.

My story is a single page in the book of how the computer and Internet were invented. Yet, it serves as a testament to what we, as a species, can achieve when we dare to dream and when we dare to envision beyond the known.

Thank you for this honor, and may we always push the boundaries of what is possible.

Philip Emeagwali.
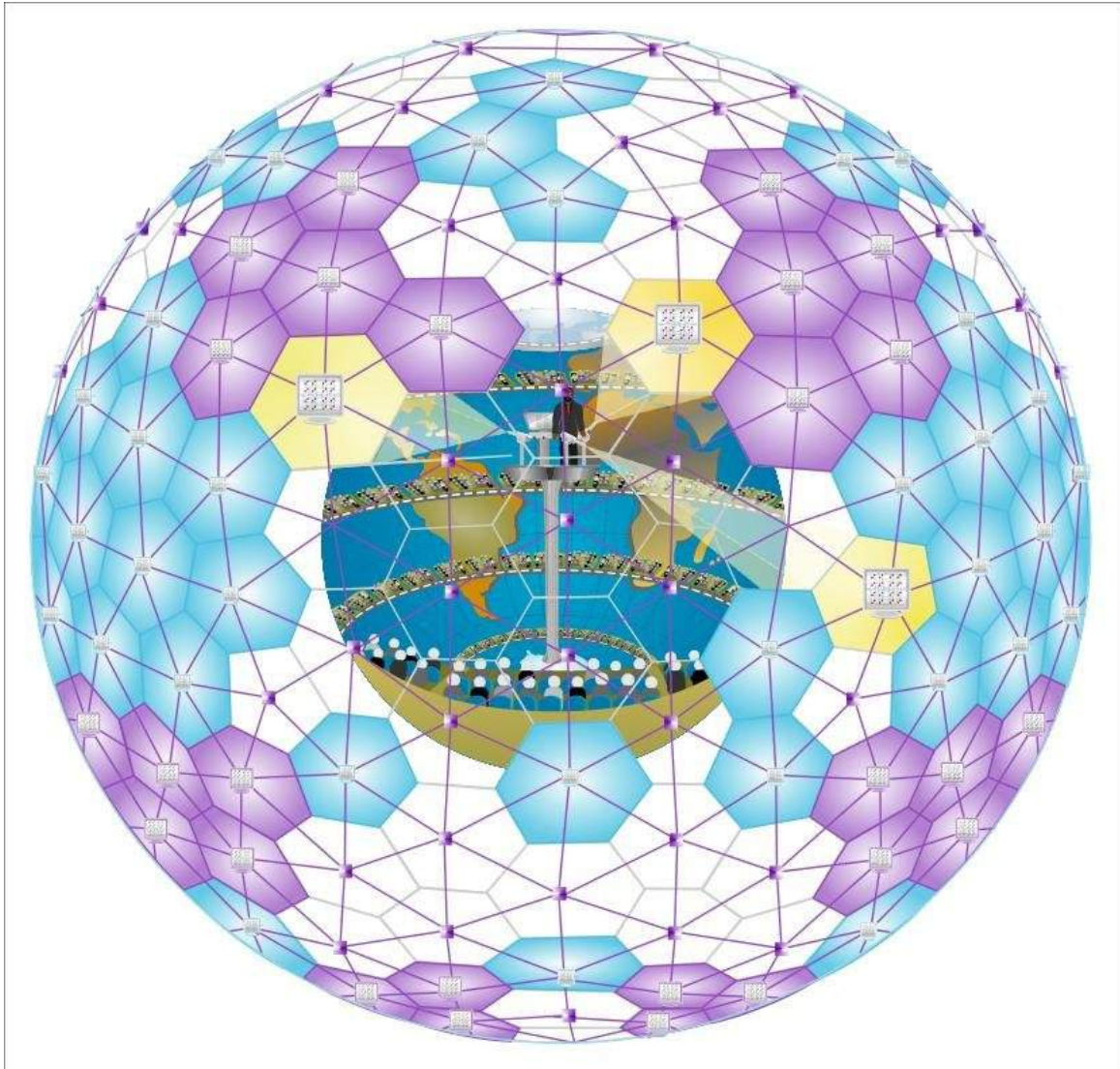
An outline of the distribution of processors in the supercomputer that Philip Emeagwali invented.

Episode 231029-1-philip-emeagwali

PHILIP EMEAGWALI INTERNET

Ladies and gentlemen, esteemed colleagues, and honored guests,

As I stand before you in this hallowed hall in your historic city, I am humbled to recount my journey through the complex world of mathematics, physics, and computer science. This journey began in Nigeria and led me to contribute not only to Africa but to the entire global community.

A question that seems simple yet contains the essence of my decades of research on how to build an Internet is this:

"How did you visualize the Philip Emeagwali Internet?"

My visualization was not merely an act of seeing but of profound understanding and connection. Envision a new global network comprising 65,536 processors etched seamlessly onto the hypersurface of a sphere, but not just any sphere. This sphere existed in the 16th-dimensional hyperspace, a realm few dare to venture into, let alone innovate within.

Drawing inspiration from our very Earth, I visualized 65,536 equal-sized atmospheres projected from our planet's surface to the boundary of space, an elevation of 62 miles or 100 kilometers. This tessellation, which existed in the 3rd dimension, became a core component of the two Internets I had the honor to conceptualize. The first, a purely theoretical entity, was constructively reduced to practice, embodying what we now recognize as a supercomputer.

The second took on a tangible form, establishing its reputation as the world's fastest computer.

I recall the moment of revelation. My breakthrough supercomputing discovery—the first world's fastest computing across multiple processors that shared nothing—made the news headlines onward of the Fourth of July 1989 in Los Alamos, New Mexico, USA. I had unlocked the potential of utilizing the slowest processors to develop what we now recognize as the supercomputer of today.

But what, you may ask, is the Philip Emeagwali Internet in its essence?

Picture a spherical island of processors encircling a globe symbolic of our Earth's habitable atmosphere, the environment at risk due to global warming. My groundbreaking discovery on that Fourth of July was not merely technical but held implications for humanity. I discovered the supercomputing blueprint for forecasting global warming with enhanced accuracy. I invented how to leverage a new international network of readily available processors. My parallel processing was an intricate dance of dialogues between components that shared nothing. Here at the crossroads

—the frontiers of human knowledge where mathematics, physics, and computer science intersected—I deciphered the complicated bond between the supercomputer and the Internet.

While my physical eyes could not perceive these 65,536 processors, my mathematical mind, sharpened by years of exploration and research, visualized them as vertices of a hypercube in the 16th dimension. This hypercube was circumscribed by a hypersphere representing a globe in a realm beyond our immediate understanding.

My discoveries and inventions pushed the boundaries of what we perceived as possible. Where once we saw limitations, I perceived opportunities. My vision of the supercomputer was more than a machine in the traditional sense but an embodiment of the Internet itself, a miniature reflection of the vast network of computers encircling our globe. In the Emeagwali supercomputer, calculations were not just computations; they were dialogues across a global network of identical processors reminiscent of the extensive Internet we interact with daily.

The journey from June 20, 1974, to today has been continuous learning, innovation, and discovery. From tackling initial-boundary value problems in calculus to navigating the intricacies of extreme-scale computational fluid dynamics, my vision of a new Internet materialized. The Emeagwali Internet is a global network of 65,536 processors, each unique yet part of a coherent whole. The Emeagwali Internet resides on the surface of a globe or hypersphere in a sixteen-dimensional hyperspace.

What is Philip Emeagwali known for?

My story is not just about invention but about re-invention. I took the seemingly impossible task of solving the most compute-intensive problems in mathematical physics. In 1989, it made the news headlines that an African supercomputer genius had invented how to harness the combined might of up to one billion interconnected processors. Though operating in isolation, each processor contributed to a larger purpose, like every individual contributes to the greater good of humanity.

Thank you for joining me in this journey towards a brighter, more connected future.
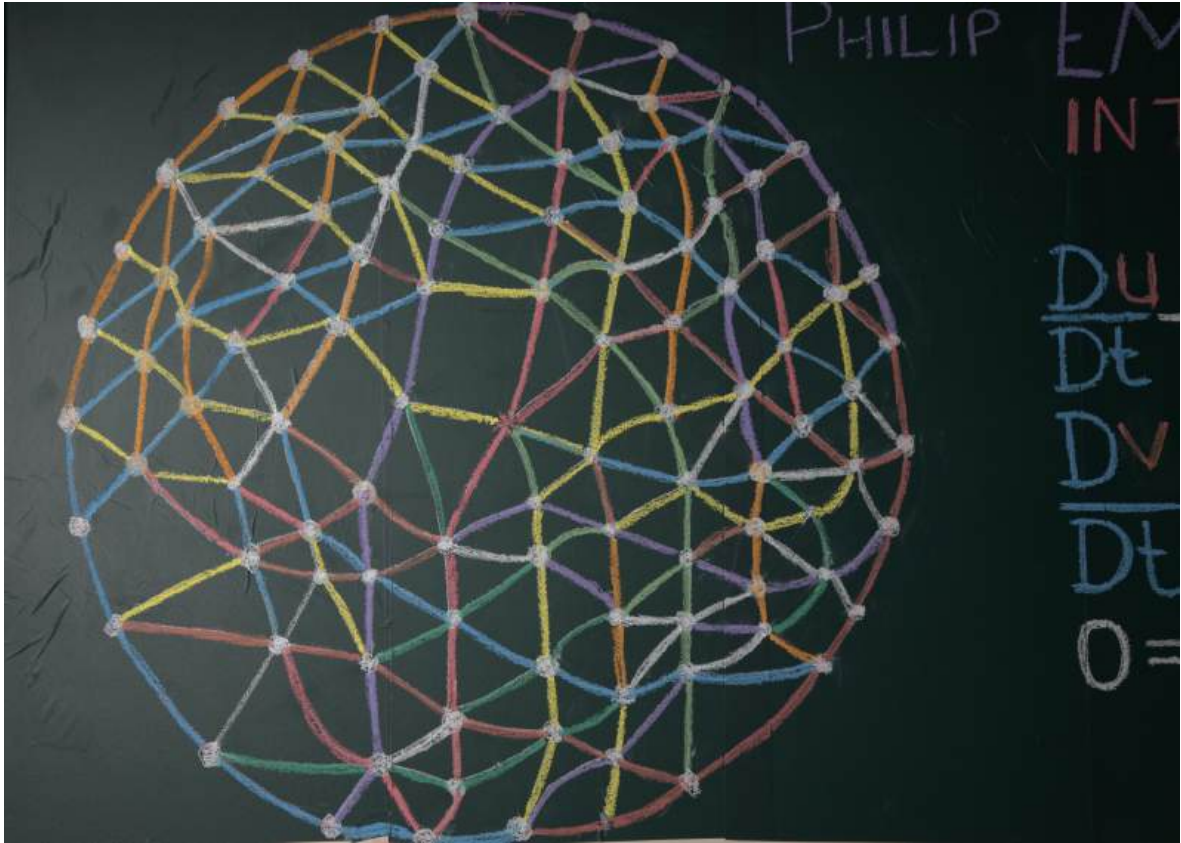
The chalkboard from a lecture on Philip Emeagwali Internet.

Episode 231029-2-philip-emeagwali

VOLUME X: PHILIP EMEAGWALI SUPERCOMPUTER

PHILIP EMEAGWALI COMPUTER

Odyssey to Transform Computing

Ladies and Gentlemen, Esteemed Colleagues, Distinguished Guests:

I stand here, humbled, as Philip Emeagwali, a representative of the persistent spirit of inquiry that permeates our collective endeavors. As I look back, my voyage has not merely been about unraveling the enigmatic nature of numbers or the profound dance of subatomic particles. It's about the ambition to elevate human understanding and capability in an age dominated by the confluence of mathematics, physics, and computer science. This journey has roots in my motherland, Nigeria, and reverberates across the heartland of Africa, echoing our continent's immense potential and promise to the enormous expanse of humanity.

Today, I wish to share a seminal chapter from this journey that addresses a pressing quandary of our digital age: communication latency in computing. The potential of the supercomputing architecture to address this pressing quandary is not just significant; it's a beacon of hope for our future. As we progress, the sheer magnitude of information we handle emphasizes how swiftly and efficiently systems can converse internally. The dimensions of computational designs, the intimacy of their connections, and their physical proximity have emerged as cardinal determinants of their prowess.

In addressing these challenges, I have envisaged a supercomputing architecture that, while being a paragon of modern design, harkens back to the natural elegance of geodesic constructs—denoting the shortest possible line between two points on a sphere. This massively parallel computer, with its processors densely packed in a spherically framed arrangement, draws inspiration from nature's geometries and, in doing so, demonstrates an aptitude, especially for climate modeling—a crucial challenge of our times. The potential impact of this architecture on supercomputing is not just significant; it's a beacon of hope for our future.

Yet, what truly sets this architecture apart is its independence from the rapid evolution of processor technology, ensuring its long-term viability. The computer's interconnects, characterized by their uniformity and brevity, facilitate communication modes ranging from intimate neighbor-to-neighbor exchanges on a spherical lattice to the complex ballet of system-synchronous clocking and packet-switched networking.

Ladies and Gentlemen, beyond the technicalities, my contributions, epitomized by this invention, aim to underscore a larger narrative. It is a narrative that champions African ingenuity in the face of global challenges. It's a testament to the limitless potential that beckons when we blend the time-honored wisdom of our land with the boundless possibilities of modern science.

I dedicate this endeavor to Nigeria, Africa, and the vast family of humanity we are all part of. This dedication is not just a commitment, but a celebration of our shared journey and the potential we hold. May it serve as a beacon, illuminating our path forward in this intricate dance of numbers, particles, and human dreams.

Thank you.

Episode 231029-3-philip-emeagwali

Retake Episode 231103-1-philip-emeagwali

INVENTING THE FASTEST COMPUTER

Ladies and gentlemen, esteemed members of the Award Committee, distinguished guests, and friends from all over the world,

I stand before you today, not merely as Philip Emeagwali. I am a representative of every dreamer, every visionary, every scientist. I represent those who dared to challenge the status quo to push the boundaries of human understanding and capabilities. It's my honor to describe my journey to the frontiers of human knowledge of the computer. My contribution of parallel processing to the supercomputer bridged the chasm between the fastest computer deemed possible and one unimaginable.

In 1989, newspapers wrote about the groundbreaking discovery of parallel supercomputing. That new knowledge heralded the advent of a new age in computing—a "final proof" that the unthinkable feat of harnessing the fastest computing power across the slowest processors was not merely science fiction, or a pipe dream, but a reality and computer science. The architect of this groundbreaking discovery was none other than yours indeed. Yet, behind the headlines lay countless hours of visualization, meticulous planning, and an unyielding belief in an audacious idea.

On the auspicious day of July 4, 1989, I conducted my final parallel supercomputing experiment that made the news headlines. But that experiment did not begin in a high-tech lab surrounded by advanced machinery. No, it commenced within the confines of my mind. I envisioned a vast sea of 65,536 processors, each with its unique topological position. This vivid image was pivotal, for accurate reservoir-to-processor mappings would remain elusive without correctly identifying each processor's location.

But the grandeur of my vision extended beyond mere processors. I perceived these 65,536 processors as being etched onto a hyper-spherical model of our very Earth, separated by an expansive three thousand square miles, each cradling equal fluid volumes. This visualization was more than a mathematical model; it represented our planet, with the laws of motion, energy, and conservation acting upon each fluid segment.

This intricate tapestry of processors, a sixteen-dimensional spherical model mapped onto our Earth, was more than an academic exercise; it represented an instrument of immense potential. It was my brainchild—the Philip Emeagwali Internet, born from an insatiable desire to simulate the intricate geophysical fluid dynamics of the air we breathe and the waters blanketing our Earth.

Imagine my profound joy when in 1989 my brainchild—"Emeagwali supercomputing" powered by parallel processing—was recognized for achieving unparalleled computing speeds, ushering in a new era in mathematics, physics, and computer science. At the crossroads of these disciplines, I tackled some of the twenty Grand Challenges of

supercomputing, resulting in a machine that, composed of the world's slowest processors, achieved the world's fastest computer speed.

My supercomputer might seem like a nebulous cloud of complex machinery to the initiated. But I envisioned it as a luminescent entity, defined by a billion twinkling lights, each representing a processor. A virtual tapestry of two-raised-to-power sixteen off-the-shelf processors, each equidistant from the other, intricately woven onto the fabric of a sixteen-dimensional hyperspace. This unique configuration gave birth to the Emeagwali Internet.

One might wonder, what does this colossal machinery resemble? Envision a bee's honeycomb but on a gargantuan scale. My theorized "HyperBall," shaped like an enormous orb, stands as a beacon of the world's fastest computing capabilities, its vastness echoing the footprint of a football stadium. If constructed to its entire scale, such a marvel will be monumental—both in cost and magnitude. With a staggering price tag that only a consortium of nations could bear, this leviathan would weigh as much as a thousand school buses and potentially consume as much electricity as a state within my beloved homeland, Nigeria.

My esteemed audience, this journey was more than creating the fastest computer. It was about pushing the boundaries of human knowledge to reshape our understanding of the universe, and above all, contribute to the growth of Nigeria, Africa, and humanity. It has been an honor to walk the path to the modern supercomputer, and I remain deeply grateful for the opportunities, challenges, and learnings it has presented.

Thank you.

Episode 231029-4-philip-emeagwali

INVENTING A HONEYCOMB SUPERCOMPUTER

Ladies and gentlemen, esteemed colleagues, and honored guests,

I stand before you, not just as Philip Emeagwali. I am a representation of every dreamer, every thinker, and every innovator. I dared to look beyond the known to find solutions in nature's intricate design. It is an honor to share the supercomputing journey I embarked upon. My contribution to the first parallel supercomputing redefined mathematics, physics, and computer science, not only for Nigeria and Africa but for all of humanity.

In the verdant landscapes of Oregon in 1974, my journey began. It was when the behemoth machines we labeled as 'supercomputers' operated on a singular pulse, a lone processor. Our supercomputing paradigm was sequential: doing one thing at a time using one processor in the zeroth mathematical dimension. However, as I delved deeper into the mysteries of algorithms for Grand Challenge problems, I began to question serial computing and demanded the more expansive canvas known as parallel supercomputing.

Nature has always been the most magnificent artist. It's the most intricate engineering. And the most profound mathematician. I observed the precision of bees and the effortless efficiency in their honeycomb construction. And I was enlightened by a parallel processing vision that would disrupt our understanding of supercomputing. Their hexagonal designs resonated with me as the epitome of efficiency. If bees, through millions of years of evolution, had converged upon this design for optimal storage and energy conservation, we could harness this wisdom for computational means.

I dreamt of an Internet, not of few, but billions of processors, computing seamlessly, in tandem, like the coordinated efforts of a bee colony. A global network, which I later termed the 'Philip Emeagwali Internet,' was envisioned as a sphere in the sixteenth mathematical dimension, encompassing 65,536 equidistant points, each corresponding to a singular processor. And like the bee's honeycomb, I dreamt of interconnecting these processors most efficiently, transcending traditional supercomputing's boundaries.

Over the years, from the serene landscapes of Oregon to the intellectually stimulating atmospheres of Washington D.C., College Park, Laramie, and Los Alamos, my comprehension of supercomputing matured, broadened, and evolved. Each destination and every challenge posed only strengthened my resolve.

I made that discovery at 8:15 on July 4, 1989 morning. The place: Los Alamos, New Mexico. With bated breath, I witnessed a supercomputer performing at unparalleled speeds. An ensemble of processors powered that first parallel supercomputing. I conceptualized the world's fastest computing across the Internet as a spherical network of processors. It was

not merely the birth of the world's fastest computer but the genesis of a paradigm shift in computational science. This global network of processors was no longer a figment of my imagination but a reality, encapsulating the globe in a sixteen-dimensional hyperspace.

However, parallel supercomputing was about more than achieving unprecedented computational speeds. It was a testament to human ingenuity, our indomitable spirit, our insatiable curiosity. Our ancient African ancestors observed nature's phenomena and derived wisdom. They're not different from us today. We still look to nature for inspiration, with a twinkle in our eyes and a dream in our hearts.

In the book that contains all human knowledge and achievement, I am a single thread weaving my discoveries and inventions. My journey to the uncharted territory of human knowledge was from observing the simple honeycomb to pioneering a groundbreaking supercomputing paradigm. I hope my contributions to science inspire a single child, or more, in the bustling cities of Nigeria, the serene landscapes of Africa, or anywhere in the world to dream bigger. In that case, my journey to the frontiers of human knowledge, which began in the hallowed halls of Corvallis, Oregon, was truly fulfilled.

Thank you, fellow scientists, for this profound honor. And to every young mind listening today, remember that the universe's most profound secrets lie in nature's simplicity. Look, observe, and let your imagination soar. And as you do, remember that the future of supercomputing is not just about speed but the boundless possibilities.

Thank you.

Episode 231029-5-philip-emeagwali

THE HIDDEN EQUATIONS SHAPING OUR WORLD

Unveiling the Marathons of Curiosity

Video link

https://youtu.be/Tnx5K6miit8

Ladies and gentlemen, esteemed colleagues, and fellow citizens of the world,

I stand before you in this magnificent city, I am reminded of the extraordinary journey that began on a summer day in Corvallis, Oregon, on June 20, 1974. At 1800 SW Campus Way, Corvallis, I programmed the first computer to be rated at one million instructions per second. My path in supercomputing was not a short sprint but a relentless marathon punctuated by tireless curiosity and an insatiable desire to expand our collective understanding of the universe.

With profound humility, I recall my early contributions to physics, starting in the 1970s. With deep fascination, I delved into the mysteries of hydrodynamics, studying the steady motions of incompressible fluids. My intellectual expedition took me to Washington, DC, where I commenced research in computational fluid dynamics, and subsequently, to the heart of the U.S. National Weather Service in Silver Spring, Maryland, where CFD is the tool used to forecast the weather.

There, I delved into the intricate world of the Saint Venant equation, pivotal in forecasting river floods and predicting the paths of catastrophic events like dam failures. These equations are instrumental for the meteorological and hydrological communities and have profound implications for understanding lake circulations and hydrodynamics across vast estuaries.

The primitive equations of meteorology, as we know them today, owe their advancements to the foundational equations akin to the Saint Venant and shallow water equations, which serve as the bedrock for predicting our everyday weather forecasts. After dedicating 13 arduous years to physics research, I was at the frontier of large-scale computational fluid dynamics.

Here, I embarked on a path-breaking journey and navigated the complex terrains of petroleum reservoir simulations across a massive network of 65,536 **interconnected yet autonomous processors.**

The culmination of this research led me to a revelation that changed the face of modern computing: the concept of parallel supercomputing. This breakthrough made the news headlines and propelled me into the annals of history as the pioneer who unified the science of parallel processing. Artificial intelligence supercomputers rely on parallel processing for their

incredible speed. This leap unlocked a multi-billion-dollar industry. It granted humanity the tools to delve deeper into previously inscrutable sciences and technologies.

The implications of my discovering parallel supercomputing are palpable, especially in the vast expanse of the oil-rich Niger Delta region of my homeland of Nigeria. Imagine the capability to pinpoint with uncanny precision the movements of crude oil and natural gas buried up to eight miles beneath the Earth's surface. Generating wealth is the promise that parallel supercomputing holds. My contributions, however, continued at discovery. I ventured further, crafting the precise partial differential equations vital for understanding the behavior of crude oil, natural gas, and even injected water across prodigious oil fields.

But what resonates with many worldwide is the discovery and its application. My crowning achievement was translating complex equations into tangible, real-world results at unparalleled speeds. This ability to concurrently solve up to a billion problems heralded a new dawn in computing.

Yet, while these achievements are monumental, the true essence of my discoveries and inventions lies not in equations or algorithms for solving the Grand Challenge problems but in the spirit of inquiry, the relentless pursuit of knowledge, and the desire to enrich humanity. It is not merely about being inscribed in academic journals read by a few but about democratizing expertise and making it accessible to millions through podcasts, videos, or social media. This ethos made me a part of the mathematics and science curriculum. To the 12-year-old, I am studied alongside the luminaries of science, such as Isaac Newton, Albert Einstein, and Marie Curie.

I express my deepest gratitude for recognizing my contribution to scientific knowledge. This recognition is not a personal accolade. The solution to the Grand Challenge problem of supercomputing is a testament to human potential, perseverance, and the indomitable spirit of inquiry. As we march toward the marriage of quantum supercomputing and artificial intelligence, let us remember that our true power lies in our ability to use the supercomputer to imagine, innovate, and inspire. And it is your support, your curiosity, and your engagement that have made my supercomputing journey to the frontiers of human knowledge possible.

Thank you.

Without my 72 differential and difference terms that represents the temporal and convective inertial forces, the Second Law of Motion is violated. And these equations become less effective as the propagate critical errors, which, in turn, reduces the amount of oil recovered.

Then the Linerized eqn (72)

becomes

Pi are the unknown vectors of grid points @ ith horizontal or vertical line

$$
\begin{bmatrix}
A_1 & B_1 & & & \\
C_1 & \ddots & \ddots & & \\
& \ddots & \ddots & \ddots & \\
& & \ddots & \ddots & B_{n-1} \\
& & & C_{n-1} & A_n
\end{bmatrix}
\begin{bmatrix}
P_1 \\ \vdots \\ \vdots \\ \vdots \\ P_n
\end{bmatrix}
=
\begin{bmatrix}
f_1 \\ \vdots \\ \vdots \\ \vdots \\ f_n
\end{bmatrix}
\quad (8)
$$

Solve by iterative method. E.g. Gauss-Seidel or SOR, accelerate with multigrid
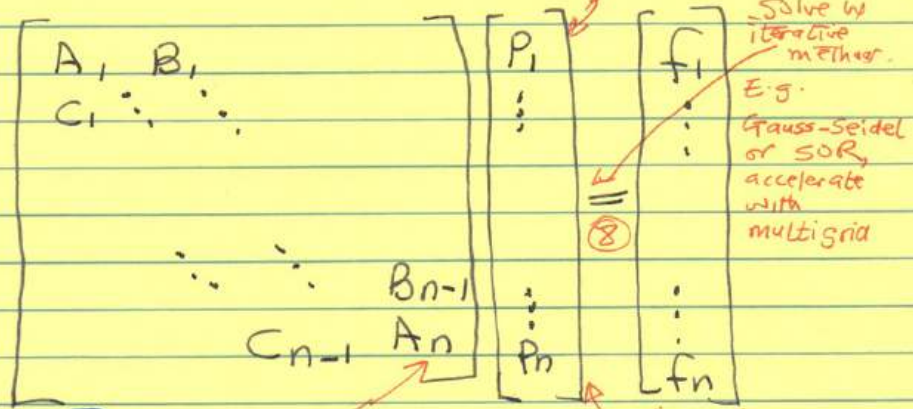
$n =$ number of vertical lines on ith horizontal or vertical line

Yields the pressure from different time steps. Also compute SATURATIONS from (3) & (4)

Each submatrix is sparse

When only 2D (x, y) (ie.), then

$A_i \rightarrow$ block tridiagonal *

C_i & $B_i \rightarrow$ block diagonal *

* Each point has two unknowns and 2×2 submatrix

each line generates a tridiagonal matrix

Use red-black ordering to email Gauss-Seidel.

black ordered 2nd

Two Dimensional Line relaxation by red-black

red ordered 1st
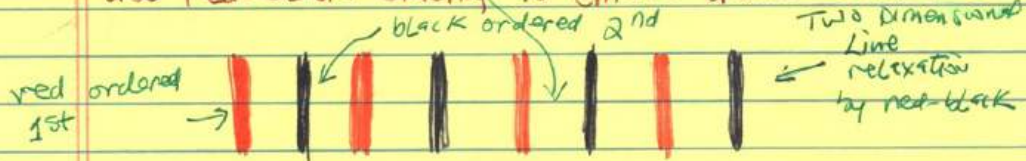
9-1111 24

In the early 1980s, I wrote about 10 pages per day, such as the above research notebooks of Philip Emeagwali.

$$UNEW = UOLD + TDTS8 * (CSHIFT(Z$$
$$(CSHIFT(CV$$
$$TDTSDX * (H - (CSHIFT(H,$$

$$\rho q_z + \frac{\partial}{\partial z}(\rho q_z)$$

$$\rho q_x$$

$$\Delta y$$

$$\Delta z$$

$$\rho q_y + \frac{\partial}{\partial y}(\rho q_y)$$

$$\rho q_x + \frac{\partial}{\partial x}(\rho q_x)$$

$$\rho q_y \quad \rho q_z$$

$$\Delta x$$

$$\frac{\partial}{\partial t} U_i + \sum_{j=1}^{n} u_j \frac{\partial u_i}{\partial x_j}$$

$$= \nu \Delta U_i - $$

$$\frac{\partial P}{\partial x_i} + $$
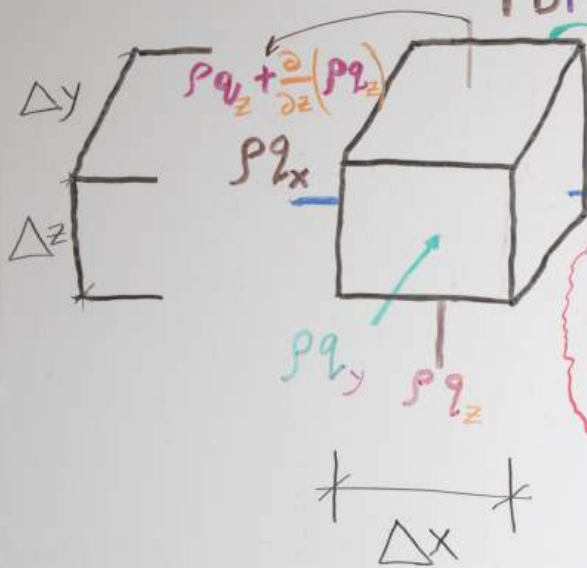
$$f_i(x,t)$$

$$\text{div } u = \sum_{i=1}^{n} \frac{\partial u_i}{\partial x_i} = 0$$

$$(x \in \mathbb{R}^n, t \geq 0)$$

$$U(x,0) = U^0(x) \quad (x \in \mathbb{R}^n) \quad \Delta = \sum_{i=1}^{n} \frac{\partial^2}{\partial x_i^2}$$

SUPERCOMPUTING'S GRAND BALLET

A Dance of a Million Processors

Video link

https://youtu.be/tJNrpthnaKU

Ladies and gentlemen, esteemed colleagues, and honored guests from the global community,

Today, I stand before you not merely as Philip Emeagwali but as a humble servant of knowledge and a devoted craftsman in the cathedral of innovation. I am known for discovering the first supercomputing via parallel processing.

Imagine a grand ballet, meticulously staged, where every dancer, attuned to the whisperings of the music and the murmurings of the cosmos, moves with grace and precision. Envision a million dancers, each embodying a distinct processor, autonomous yet subtly interconnected, initiating their performance in sublime unison, moving through the grand narrative of computation in tandem, concluding their dance with a harmonious finale that resonates through the silent hallways of the universe.

Such is the ballet of the modern supercomputer, a canvas where art and science, poetry and logic, vision and execution, dance together in a perpetual, mesmerizing dance.

On a day marked by the brilliance of independence, July 4, 1989, I glimpsed a canvas painted with the colors of possibility and outlined with the contours of the future. On this historic day, a revelation dawned upon my conscience, illuminating the path of parallel processing where a million processors, independent yet interconnected, shared nothing yet everything, could be harnessed to solve and unravel the Grand Challenges of our times. This transformative power of parallel processing, and this collaborative nature of supercomputing, this ability for a million processors to work together, is the essence of the technological foundation of A.I. supercomputers. It is a testament to our connectedness and the power of collective effort in the technological community.

This parallel supercomputing was not merely a discovery; it was a symphony of understanding and insight, a harmony of knowledge and

intuition that enabled us to foresee the unseen and predict the unpredictable, like the ominous shadows of global warming that subtly dance on the horizons of our collective consciousness.

Parallel processing revolutionized the visage and the essence of the supercomputer. It shifted our gaze from the isolated prowess of a singular processor to the harmonious and symphonic dance of millions. It changed how we perceive supercomputers and engage with, comprehend, and utilize them.

Now, let's take a moment to revisit and reinterpret Amdahl's law through a metaphor infused with life and dynamism. Visualize the execution time of a supercomputer as a grand tapestry where each thread is woven meticulously, representing a unit of time. The tapestry is linear, limited, and confined in a singular processor. However, when multiple processors are introduced into the loom, the tapestry transforms and expands, morphing into a dynamic, multidimensional artwork representing a living embodiment of time and computation.

Yet, the metaphor extends further, for Amdahl's law reminds us that the parallel symphony has constraints and limitations. Not all threads can be woven simultaneously; not all dances can be perfectly parallelized. Hence, the craft is in balancing, understanding the dance and the dancers, the computation and the processors, and navigating through the labyrinth of possibilities with the compass of wisdom and the map of knowledge.

Together, let us continue this wondrous journey through the landscapes of computation and the horizons of understanding, for the dance is far from over. The ballet of the supercomputer, with its million processors, continues, telling tales of possibilities and singing songs of the future.

Thank you for your attention, commitment, and belief in the dance of knowledge and the ballet of innovation.

R Episode 231029-7-philip-emeagwali

OF CHICKENS AND OXEN

Ode to the Human Spirit in Supercomputing

Video link

https://youtu.be/eOuQXC_fZ9U

Ladies and gentlemen, esteemed colleagues, and honored guests,

I stand before you today, not merely as Philip Emeagwali but as a humble representative of the audacity of human imagination, the relentless pursuit of knowledge, and the indomitable spirit of innovation that resides within us. It is my unparalleled honor to address this august assembly and share the voyage that led to the reimagining and reinvention of the modern supercomputer.

The dawn of the digital age presented a canvas where two paradigms loomed large: the Chicken and the Oxen. In our discourse today, the Chicken symbolizes the seemingly insignificant, the world's slowest processors, while the Ox represents the might of a singular, potent processor. It is through the dance between these dichotomies that a symphony of unparalleled computational power was orchestrated.

The computing colossus was envisaged as an Ox—robust, stalwart, and singularly powerful for years. But as we stared into the abyss of the Grand Challenges that bespeckled the horizon of scientific inquiry, it became abundantly clear that brute force alone could not unveil the tapestry of the universe's deepest secrets.

On the illustrious day of July 4, 1989, as the United States celebrated the annals of its freedom, another form of emancipation was silently unfolding in bits and bytes. On this day, I, a lone researcher armed with a vision, stumbled upon a revelation that would irrevocably alter the trajectory of supercomputing.

In the canvas of my imagination, a million Chickens—not isolated but interconnected, not disparate but harmonious—fluttered their wings in a mesmerizing dance of precision and collaboration. Each processor, although slow on its own, became an integral note in a grand symphony, contributing to a chorus that echoed through the silicon valleys and digital mountains, crafting a melody of unprecedented computational might.

Through this discovery, the concept of parallel processing was not just vindicated but celebrated. It illuminated the path for harnessing the collective might of millions of slow processors, computing in an

enchanting ballet of coordination and autonomy to unravel the Grand Challenges that had long eluded our grasp.

Parallel processing revolutionized our vision and understanding of supercomputing. It is not the solitary giant but the assembly of the seemingly weak, not the isolated brilliance but the tapestry of collective endeavor, that holds the key to unlocking the treasures of computational majesty. Parallel processing empowers the massive computational capacity of A.I. supercomputers.

In the unfolding narrative of supercomputing, parallel processing emerged not merely as a technical methodology but as a philosophical revelation, underscoring the power of unity, the promise of diversity, and the unexplored potential residing within the 'small' and the 'many.'

As we gaze into the future, let the tale of the Chicken and the Ox be a beacon, illuminating the infinite possibilities that arise when power is decentralized, when contribution is democratized, and when the symphony of collaboration drowns out the solo of dominance. The potential of parallel processing is vast, and it is this potential that should fill us with optimism and hope for the future of supercomputing.

Ladies and gentlemen, the invention of the modern supercomputer is not the tale of technology alone. It is the story of vision, collaboration, the relentless pursuit of knowledge, and the belief in the unlimited potential of human imagination and endeavor. The tale of a million Chickens outperforming the Ox is our shared legacy, a testament to the ingenuity and resilience of the human spirit.

I thank you for allowing me the opportunity to share this journey with you, and it is my earnest hope that the saga of parallel processing and supercomputing continues to inspire and guide future generations of scientists, researchers, and dreamers as they chart unexplored territories of knowledge and innovation.

Thank you.

R Episode 231030-1-philip-emeagwali

154

BRIBES AND BREAKTHROUGHS

Ladies and Gentlemen, esteemed conference attendees,

I am Philip Emeagwali, a scientist who has ventured through the uncharted terrains of partial differential equations, planetary-scale fluid dynamics, and massively parallel supercomputing. Today, I am here to narrate my journey to the frontier of human knowledge. My seven-decade long journey spans continents and disciplines. I want to share how my pursuit of knowledge in supercomputing has paralleled the challenges and discoveries of travel.

My first trip to the United States began with a significant hurdle: obtaining a Nigerian passport. The process was fraught with obstacles that tested my resolve. I remember the heat and dust of those long journeys from Onitsha to Lagos on rickety lorries called mammy wagons, farm trucks used for transport.

The discomfort was a small price for the opportunity that awaited me. In Lagos, I encountered a system steeped in bureaucracy and corruption. The Nigerian passport office at 27 Kakawa Street was a maze where one could quickly lose their way amid fraudsters and unscrupulous officials.

In September 1973, I was awarded a scholarship to study in Oregon, a golden opportunity that felt like a dream. However, the corrupt practices at the passport office threatened my dream. Despite my reluctance, the urgency of securing my passport to study in the USA compelled me to succumb to the system's demands, to pay a bribe of five pounds and a non-refundable fee of 150 pounds, a decision I made with a heavy heart.

This experience at the passport office was a stark introduction to the challenges many face in pursuing their dreams. It taught me the resilience needed to navigate often obstructive systems rather than facilitative. But more importantly, it underscored the need for integrity and systemic change in our institutions.

Once I secured my passport and visa, my path to the United States was clear. But the journey was more than a physical relocation; it was a transition into a world of supercomputing, where I would delve into parallel processing, computational physics, and the complexities of partial differential equations.

In supercomputing, I discovered a world where collaborative efforts, like the combined efforts of processors in parallel processing, lead to groundbreaking achievements.

My contributions to supercomputing, particularly in developing methods for petroleum reservoir simulation, weather forecasting, and general circulation modeling, were about tackling complex problems that required a nuanced understanding and innovative approaches. I remember the late nights and early mornings spent in a dozen computer labs. I remember the moments of frustration when a solution seemed out of reach. And I remeber the exhilaration of finally cracking the Grand Challenge problem of large-scale computational mathematics.

My journey, fraught with challenges, mirrors the journeys of many who seek to explore new territories, whether in science, literature, or the world. The pursuit of new mathematical knowledge and the journey of exploration of world's fastest computing are often filled with unexpected obstacles and incredible opportunities for growth and discovery.

As we navigate our respective paths, let us remember the lessons from these journeys. Let us strive for a world where the pursuit of knowledge and opportunities is not hindered by corrupt systems but facilitated by environments that nurture potential and innovation.

Lessons Learned

"Challenges test our spirit but overcoming them shapes our character and resilience."

"Embrace unexpected connections; a bumpy ride on a mammy wagon can lead to supercomputing success."

"Collaboration is key; diverse perspectives unlock the true potential of knowledge and solutions."

"The world is your laboratory; explore, discover, and leave your mark on its landscape."

"Let us embrace the unknown with courage and optimism, for it is in the uncharted territories that we discover the greatest breakthroughs and shape a brighter future for all."

"The future belongs to those who dare to dream, innovate, and be driven by an insatiable curiosity to explore the vast unknown."

Thank you for joining me on this journey today, and may your travels, whether through the landscapes of our planet or knowledge and imagination, be filled with enriching experiences and transformative discoveries.

A JOURNEY BEYOND BOUNDARIES

The Inspiring Tale of Philip Emeagwali

Date: March 23, 1974
Location: Lagos, Nigeria
Destination: The United States of America

Ladies and gentlemen, I stand before you not just as Philip Emeagwali but as a testament to the scientific dreams that can be realized when one dares to leap beyond familiar shores of computing. On a day that now seems a lifetime away, I, a skinny 19-year-old Nigerian, embarked on a journey that would redefine my destiny and echo the aspirations of many young minds like yours.

Picture this: Nigeria, 1974. President Yakubu Gowon was at the helm, and I, in my youthful naivety, knew little of the world beyond our borders. Richard Nixon led the United States, a fact unknown to me then, and Nelson Mandela's struggle was yet to become a global rallying cry. My world was more Newton's laws than the Queen of England's reign.

Dawn broke over our compound in Asaba, a stone's throw from Saint Patrick's College and General Hospital. There, amidst the familial warmth of my father, a nursing superintendent, and the eager embrace of my siblings, I bid farewell to a life I knew. As my mother and I journeyed to Onitsha, the reality of my venture—to the fabled Obodo Oyibo, the United States—began to crystallize.

Boarding the Mid-West Line bus, my excitement was tinged with the anxiety of 'the Nigerian factor'—the unpredictable elements that could derail carefully laid plans. Fearing delays, I made a bold decision in Benin City: to switch to a Mercedes Sedan, hurtling towards Lagos at a heart-stopping speed, driven by a driver more concerned with not missing that afternoon's soccer match than passenger pleas.

At Ikeja Airport, Lagos—then a relatively serene gateway compared to today's bustle—my understanding of the world expanded. I learned the hard way about currency exchange, prompted by an agbero's cunning offer for my Naira. This led to an impulsive shopping spree, including a magazine featuring Fela Kuti, an emblem of Nigerian spirit and defiance.

Standing before the colossal Pan American World Airways airplane, the 366-passenger Boeing 747-100, my awe was palpable. The planes I'd known were distant specks in the sky, not these towering machines capable of crossing continents. As I stepped aboard, a sense of wonder enveloped me—a feeling only heightened by encounters with fellow travelers, each with their stories and dreams.

The flight was a revelation. The diverse tapestry of passengers, the unexpected encounters—like the joy of reconnecting with an old classmate

now working in immigration, who fondly recalled my knack for calculus—all these moments painted a vivid picture of a world interconnected yet vast in its differences.

Landing in New York was like stepping into a dream. I felt like I had fallen into the fourth dimension. The sheer scale of everything—the people, the architecture, the pulsating energy was overwhelming. With only $134 in my pocket, I felt like the wealthiest man alive. I was buoyed by the promise of a scientific future ripe with possibilities.

So, to you, the aspiring minds of Nigeria, I say: let my journey inspire you. Let it be a reminder that a world of opportunity lies beyond these shores, ready for the taking. Your dreams, like mine, may seem distant, a mere speck against the vastness of the unknown. But with the courage to make bold decisions, the determination to overcome obstacles, and an unyielding belief in your potential, you too can traverse oceans, break barriers, and write your story in the annals of history.

As I stand here, a Nigerian-American, the inventor of supercomputing via parallel processing, who once knew more of Isaac Newton than Martin Luther King Jr., who saw a distant, almost mythical land in America, I urge you to dream, strive, and soar. For in you lies the promise of a future as boundless as the Oregonian skies that once used a scholarship letter dated September 10, 1973, to call a Biafran refugee from Onitsha.

Thank you.

LAGOS STREETS AND MEMORIES

My Everlasting Connection

Video link

https://youtu.be/SxKU_Pd2wAw

As I sit here reminiscing about that fateful day, the memories of Surulere flood my mind. I was transported to the overcrowded motor park at Ochanja Market of Onitsha and to the vibrant streets of Surulere, Lagos in early October 1973. I am Philip Emeagwali, an Onitsha indigene. I was born on August 23, 1954, in a Boy's Quarter in the compound of 11 Ekemeso Street in the small town of Akure in the Western Region of colonial Nigeria. Allow me to take you on a journey that began in colonial Africa as I share the story of my first arrival in Lagos from Onitsha, East Central State, Nigeria.

I was in Lagos about ten days after I received a scholarship to study in the USA. The scholarship took effect on September 10, 1973, but I was ready to arrive nine months earlier. To get a Nigerian travel passport and an American F-1 student visa, I found myself in Surulere or around Tinubu Square or in Victoria Island, three iconic communities in Lagos's heart, a city about as populous as the entire state of New York.

Philip Emeagwali, Onitsha, Nigeria, June 1973.

I woke up at four o'clock with a sense of anticipation. I was ready to face the day. I knew I was one step closer to my dream of studying in America. I took the overcrowded "Molue," or "Danfo," bus from Surulere to the Nigerian Passport Office along the bustling Kakawa Street. That was my daily destination for almost three months, from early October to late

December 1973. I walked through the streets of Surulere, witnessing Lagos's pulse as it thrived around me.

The city enveloped me with its vibrant energy and diverse cultures. Lagos was a melting pot. Five hundred and twenty-five languages intermingled in Lagos. And traditions clashed and harmonized in a symphony of life. The sights, sounds, and scents of Tinubu Square were an intoxicating blend. Those few weeks in Lagos fueled my curiosity and ignited my sense of adventure.

Arriving at the Passport Office, I joined the sea of students with their aspirations and dreams. We waited patiently in line, eager to fulfill the necessary procedures that would allow us to cross borders and enter the United Kingdom or the United States. The bustling activity, the murmur of conversations in pidgin English, and the anticipation in the air created an electric atmosphere.

Time moved differently within the walls of the Passport Office. For the young Nigerian, Kakawa Street was where dreams intersected with reality. It was where aspirations took shape on paper. And where I forged my destiny. Finally, on December 27, 1973, it was my turn to smile. I paid a hefty bribe of five pounds. The government official examined my documents. And stamping them with a sense of finality. I was one step closer to Oregon, United States, and three months away from my scholarship expiring.

I stepped onto the sunlit streets of Lagos. A mixture of excitement and nostalgia washed over me. I knew my time in this vibrant city was limited, But the memories of Lagos I would carry would be everlasting. Surulere had become a temporary home. A place where I connected with the spirit of Nigeria. Lagosians left an indelible mark on my journey.

Between three to six o'clock in the afternoon on Saturday, March 23, 1974, I was with about six passengers. I was anxiously pacing inside Ikeja Airport. And, perhaps, the only prospective student at the airport. At 6 p.m., I cautiously boarded the Boeing 747 airplane and bid farewell to Nigeria. Thirty-six hours later, I reached my destination: 36 Butler Hall, Monmouth, Oregon, in the Pacific Northwest region of the United States. In Corvallis, Oregon and, three months later, I began supercomputing. I was recognized as a computer science pioneer, fifteen years later. On July 4, 1989, I became the first person to discover the first supercomputing implemented by parallel processing. I became the first and only person to invent an Internet that's a global network of processors. The Internet is an international, or worldwide, network of computers.

Over fifty years later, I carry a piece of Lagos within me. The city's energy, vibrant streets, and unity of its people shaped my aspirations and fueled my drive to make a difference.

Today, as I reflect on that pivotal day when I first arrived at Iddo Motor Park, Lagos, I am grateful for the opportunities that Nigeria bestowed upon me. The memories of 39 Okesuna Street, the Passport Office at 27 Kakawa

Street, and the Embassy of the United States on Victoria Island remain etched in my heart. They remind me of my humble beginnings in Biafran refugee camps and the importance of embracing one's roots.

My journey from Lagos to Portland, Oregon, was just the beginning. And my story continues to unfold. But I will forever cherish the city that welcomed me in October 1973 with open arms, for the seeds of my dreams were sown in Okesuna and Kakawa streets of Lagos. And in the U.S. Embassy on Victoria Island, I rekindled my determination flame. That first flight from Ikeja Airport propelled me towards a future that exceeded my imagination.

Episode 231030-2-philip-emeagwali

VOLUME Y: VISA TO THE USA

Lagos, 1000 SS3s

Distinguished guests and the future of Nigeria—our vibrant youths. I stand before you as proof of the power of dreams, perseverance, and the unyielding spirit of our Nigerian heritage. I am Philip Emeagwali, the inventor of supercomputing via parallel processing some of you encountered in your "Computer Studies" at age 13 at the Junior Secondary School. You studied my contributions to the development of the world's fastest computer. I am a son of Nigeria. In 1973, I stood where you are today and dreamt of a future at the frontiers of scientific knowledge.

Let me take you back to a turning point in my journey to discover parallel supercomputing: March 20, 1974. Picture a teenage Nigerian standing with hope and anxiety outside the Embassy of the United States of America in Lagos. That teenager was me, about to face a visa interview that could change my life.

I remember the small talk with about 20 other visa interviewees, the nervous energy in the air, and the warning from one of them: "You'll be back ten times before you get a visa." But inside me, there was a flicker of hope, a belief that today might be my day.

The interview itself was brief—just five minutes and five questions. What stood out were not the questions but the items I presented: test scores from Britain and the United States, reflecting my journey as a self-taught and independent student. My education was unconventional, a testament to the abundance of resilience and resourcefulness that you possess.

When the interviewer, Mr. Glasl, examined my documents—my diploma from the University of London, my scholarship letter from Oregon, and my three American test scores—and finally said, "Congratulations," I was overwhelmed. His American accent made it hard to understand his words, but the meaning was evident when I walked out holding a colored card—a symbol that my F-1 student visa would be stamped. The disbelief in the eyes of the other interviewees was a mirror of mine.

As I left the embassy, holding that precious card, I felt a whirlwind of emotions: confusion, excitement, and a sense of achievement. I remember thinking, "What next?" I felt like I had been chasing a dream, like a dog chasing a pickup truck, and suddenly, I was on board, wondering what to do.

I got into a taxi, and in pidgin English, the driver asked, "Were you dey go?" In that moment of uncertainty, I blurted out, "Tinubu Square," a place symbolic of our nation's heart and history. It was a transition from dreams to reality, from aspirations to achievements.

My journey from that day led me to make contributions to computer science. My invention of the first parallel supercomputing is globally recognized and studied in schools. Solving that Grand Challenge problem taught me that no matter where you come from—such as a refugee camp, no matter the odds stacked against you—as an African immigrant in the U.S., your dreams to contribute to scientific knowledge are valid, and your potential is limitless.

So, to you, I say: dream big, work hard, and never give up. I began my journey to the frontier of human knowledge from the Biafran refugee camps of the last 30 months of the 1960s. In Biafra, all schools were closed for three years. Your journey might be filled with challenges, but remember, these challenges forge the most robust steel. You are the future of this great nation. I do not doubt that you will rise to shape a brighter and better world. And invent computers faster than I could even imagine.

Thank you.

A LEAP OF FAITH, JOURNEY TO MONMOUTH

Video link

https://youtu.be/MRXyFIW2zA0

March 21, 1974, in the heart of Victoria Island, Lagos, Nigeria. The U.S. Embassy towered like an emblem of hope for me and the many gathered there. It was both intimidating and inspiring. Around me, at the reception, were about twenty others, all eagerly waiting, all bearing the same hope in their eyes. All eager for that ticket to a dream, the F-1 Student Visa.

The well-dressed folks around me exchanged pleasantries and stories of their previous attempts. "How often have you been here?" a gentleman asked. "First time," I responded. The room was filled with smiles but also a cautionary undertone. One shared, "Prepare yourself; it might take up to a dozen visits over five years." Their eyes spoke volumes of the grueling wait and relentless pursuit of this dream. But hope was a constant.

As the clock struck 10:30 A.M., my name echoed across the room. Mr. Glasl, the consular officer, was ready to interview me. Though he looked out of place in his vacation attire, his aura was commanding. I approached him with the confidence of someone who had a vision. The next fifteen minutes were intense, but my scholarship to Oregon was my ticket, and perhaps my passion was palpable.

Walking out with the Blue Card was nothing short of a miracle. The gasps and surprised faces were evidence of that. That card wasn't just a pass for me; it represented dreams, determination, and a journey I was about to embark on.

Just a few minutes later, I found myself in a black Morris Minor taxi, navigating through the bustling streets of Lagos. The city was alive with its usual hustle, seemingly unaware of the turning point I had just experienced. The taxi dropped me off at 49 Okesuna Street, my temporary residence. Every moment was a step closer to the United States, a quest for knowledge that would transform me in ways I couldn't yet imagine.

By 2 o'clock the next day, I was at the Iddo Motor Park, Lagos, with my modest travel bag. The Peugeot 404 Sedan was my ride to Asaba, the last stretch of my Nigerian journey. As the landscape of Nigeria zoomed past me, memories, emotions, and dreams intertwined. I was going to Monmouth, Oregon, but it was more than a geographical transition. It was a leap into the limits of supercomputing.

To the young Africans reading this, my discovering the world's fastest computing via parallel processing is a testament to the power of dreams and perseverance. The world's fastest computer is not just a milestone; it is a pathway to innovation, change, and a better future. Its vast resources and opportunities can be the playground where you mold your ideas into reality. But remember, my journey to the limits of computing started in a Servant's Quarters at 11 Ekemeso Street, Akure, Nigeria, 19 years before my first plane ride, right when I dared to dream.

And so, I urge you to dream big, think faster computers, work hard and let the world be your oyster. The subsequent groundbreaking discovery in quantum computing, the next life-changing invention in artificial intelligence, could have your name on it. The journey to the next big thing beyond A.I. will be challenging, but I promise it will be worth it.

Episode 231030-3-philip-emeagwali

Philip Emeagwali. This photo of me at age 17 was taken by a photographer across the street from the Catholic church in Ibuzor, Midwest, Nigeria (~ July 1972).

A JOURNEY OF DISCOVERY

Philip Emeagwali's Inspirational Odyssey from Nigeria to the United States

March 23, 1974, marked a transformative day in the life of a young Nigerian, Philip Emeagwali, a name now synonymous with supercomputing and extraordinary intellect. In a videotaped speech for Lagos, Nigeria, before an audience of aspiring Nigerian youths, Emeagwali recounted his journey from the refugee camps of war-torn Biafra to the bustling streets of Onitsha and Lagos to the fastest computers in the technologically advanced landscapes of America.

At the tender age of 19, with Nigeria under the leadership of Yakubu Gowon and unfamiliar with international figures like Richard Nixon or Nelson Mandela, Emeagwali's world was about to expand beyond the boundaries of his imagination. His knowledge was rooted in figures like Isaac Newton, who overshadowed even the Queen of England in his mind. That morning, as he uttered 'Monmouth' and 'Oregon,' little did he know how these destinations would shape his future.

Emeagwali's day began at 7 a.m. in Asaba, close to Saint Patrick's College and General Hospital, where his father worked as a nursing superintendent. His family, comprising his siblings—Francis, Florence, Edith, Martin, Evelyn, Peter, and the youngest, John Bull, shared heartfelt goodbyes, unaware of the monumental journey upon which their brother was about to embark.

Joined by his mother, Emeagwali's trip to the Onitsha bus station was the first leg of a journey filled with anticipation and anxiety. He initially boarded a Mid-West Line luxury bus, only to switch to a Mercedes Sedan in Benin City, driven at breakneck speeds by a driver more concerned about not missing a soccer match in Lagos than passenger safety. These moments, fraught with the "Nigerian factor" of unpredictability, were emblematic of the challenges he would later conquer.

Departing from Lagos, Emeagwali experienced a series of firsts: his first airport visit, his first encounter with a plane up close, and the first time he realized the limitations of Nigerian currency abroad. Amidst this flurry of new experiences, he indulged in a magazine featuring Fela Kuti and purchased a striking Nigerian shirt emblematic of his roots.

The enormity of the Boeing 747, operated by Pan American World Airways, left him in awe. His ticket, a symbol of faith purchased well in advance from Nigeria Airways, was his gateway to a new world. The journey was not just a physical transition but a voyage into the unknown, filled with wonder and apprehension.

En route to New York, Emeagwali's observations of fellow passengers, including the elegantly dressed Senegalese ladies, broadened his perspective on African diversity. Upon landing in New York, his awe was palpable. The airport, the people, the buildings—were magnified compared to his experiences in Nigeria.

With only $134 in his pocket, Emeagwali stepped onto American soil, not just in search of education but in pursuit of a dream—the world's fastest computers. A supercomputer that costs more than the second River Niger bridge at Onitsha seemed almost unattainable from his humble beginnings, namely, the soup lines of an overcrowded refugee camp in Biafra. His journey to the uncharted regions of human knowledge, peppered with moments of fear, excitement, and revelation, is a testament to the power of determination and the unyielding spirit of curiosity.

As he concluded his speech, Emeagwali's message to the Nigerian youth was clear: "Embrace the unknown, for it is in the unknown that we find ourselves and our purpose. Let my journey be your inspiration. Dream big and let nothing hold you back."

This speech, a captivating narrative of a remarkable journey from a refugee camp to computing greatness, is more than just a story. It's an inspiration, a beacon of hope for young Nigerian scientists and people worldwide, reminding them that their circumstances do not

define their future but rather their power of
 determination to pursue their dreams.

NEVER STOP SAYING YES

Distinguished guests,

As I stand before you, I am reminded of a journey that began on Thursday, June 20, 1974 morning, at 1800 SW Campus Way, Corvallis, Oregon. That was when and where I started programming the first computer to be rated at one million instructions per second, back when it was manufactured in December 1965. My journey to the unknown parallel supercomputing continent has brought me here to this prestigious platform.

I am Philip Emeagwali, and I am here to share my contributions to supercomputing, parallel processing, computational physics, and the solution of partial differential equations. Artificial intelligence supercomputers rely on parallel processing as their core technology. I was the first to discover supercomputing via parallel processing. It made the news headlines when I found the first supercomputing, on the Fourth of July 1989, in Los Alamos, New Mexico, USA.

I recall the day of Saturday, March 23, 1974, at the Midwest Line bus station in Onitsha, Nigeria. With my mother and aunt, Mama Felicia, by my side, I embarked on a journey to the United States, fueled by a dream and a spirit that said "yes" to the challenges ahead.

Mama Felicia, though illiterate, understood the significance of this journey. She compared my path to Nnamdi Azikiwe, a notable figure in Nigerian history. Her words, rooted in Igbo spirituality, resonate with me: "When a man says yes, his chi, or spirit, says yes also."

My arrival in Oregon was a cultural revelation. The sea of unfamiliar faces and the absence of anyone who looked like me starkly contrasted my life in Nigeria. It was a moment of realization about the diversity of the world and the varied experiences of people of African descent. This period was marked by encounters that shaped my understanding of identity and belonging.

Amidst this cultural transition, I remained focused on my passion for computing. In 1974, when I spoke of programming the first supercomputer, capable of a million instructions per second, it seemed an unbelievable feat to many. At that time, the concept of supercomputing was still in its infancy, and my Nigerian peers viewed such endeavors as reserved for geniuses and wizards.

My mathematical contributions to supercomputing, mainly parallel processing, have been driven by a desire to solve complex problems. I focused on developing algorithms and techniques to harness the power of multiple processors. They must work in tandem to perform computations at unprecedented speeds. My approach—27X *******- I invented supercomputing via parallel processing—revolutionized computational physics. That discovery enables us to tackle large-scale problems such as

172

weather forecasting and general circulation models more accuracy and efficiently.

The journey that began in Onitsha led me to explore the depths of partial differential equations, which are fundamental to understanding various phenomena in physics and engineering. Parallel processing has contributed to a deeper understanding of these equations and their practical applications in real-world scenarios, such as a more profound and surer understanding of the dynamics of Earth's atmosphere and oceans.

Reflecting on my journey to the land of supercomputing via parallel processing, I realize solving the Grand Challenge problem is a testament to the power of perseverance and curiosity. It is the relentless pursuit of mathematical and scientific knowledge. And also a story of bridging worlds—from the heart of Africa to the frontiers of mathematics, physics, computer science, and their neighboring sciences.

I stand before you as a polymath, a symbol of hope, a reminder that the pursuit of knowledge has no boundaries. It is a technological journey that transcends continents, cultures, and the limits of our imagination.

Lessons Learned

"My journey began in Onitsha, fueled by a dream and a spirit that dared to say 'yes' to the impossible."

"From the sea of unfamiliar faces to a global stage, my journey is a testament to the power of embracing diversity and bridging cultural divides."

"Supercomputing was a dream, not just for me, but for countless others who believed in the potential of parallel processing."

"Equations are not just symbols; they are whispers of the universe, revealing its secrets to those who listen with open minds."

"Weather whispers, oceans echo, and my partial differential equations translate their murmurs into insights for a sustainable future."

Thank you for honoring me with your presence today and for joining me in the spirit of discovery that unites us all in our quest for understanding and innovation.

BEYOND THE HORIZON

Philip Emeagwali's Remarkable Odyssey

Dear aspiring minds and future leaders,

I stand before you today, as Philip Emeagwali. I am a Nigerian-American computer scientist widely studied in schools for his contributions to science. I invented supercomputing via parallel processing. That new knowledge is what makes the world's fastest computers fast. Its studied in schools as a significant contribution to developing the world's fastest computers. As a teenager, I dropped out of school for five years, althoug I was an outstanding student. I grew up in refugee camps in war-torn Biafra, where one million people died from hunger and starvation. I am a living embodiment of the adage that life is a journey, not a destination.

Let me take you back to a defining moment in my life. It was 7 p.m. Sunday, March 24, 1974. After a 36-hour-long trip from Asaba with stopovers in Onitsha, Benin City, Lagos, Monrovia, Dakar, New York City, and Chicago. I found myself in Portland International Airport, Oregon. I was pacing alone inside the airport and clueless about how to get to Monmouth. I was apprehensive because I didn't know where in Portland to spend the night. After a telephone call by an airline official, she told me to head towards 36 Butler Hall, a dormitory in Monmouth, a quaint 6,000-person university town I had only read about in the school's brochures.

The Oregon I discovered was unlike anything I had known. Its air was cold, crisp, and fresh, starkly contrasting to my homeland. I was mesmerized by the beauty of Oregonian landscapes. The homes were elegant. Their lawns were manicured.

Upon my arrival in Salem, three students—a welcoming committee of sorts —greeted me. They drove me to Monmouth. The journey in their Chevy Impala, driven by a teenage girl no less, was a novelty for me, as was the vehicle's sheer size and the liberating concept of young women holding driver's licenses.

As we approached Monmouth, my mind buzzed with curiosity and anticipation. What would the Oregon College of Education look like? This question loomed large as we neared our destination.

Upon reaching Butler Hall, my new home, Helen, the resident manager, greeted me. She was a kind, petite elderly lady who showed me to Room 36. That night, as I unpacked in my near-empty but spacious room, I was interrupted by Helen, who informed me of a telephone call waiting for me —my first telephone call. The experience was alien and awe-inspiring as I struggled to familiarize myself with the telephone, a stark reminder of the technological chasm I had crossed from Nigeria.

My first night in that dormitory was a quiet reflection of the monumental change I had embarked upon. Standing on the balcony, gazing into the serene Oregonian night, I felt awe and homesickness. I was a child far from home yet on the cusp of something great.

In those early days, I supported myself through part-time jobs that paid one dollar and sixty cents an hour, including stints as custodian, library assistant, and canner in food canneries in Salem, the cannery capital of the world that employed thousands of illegal Mexican workers. I formed a lasting friendship in the library with Mary Boyarsky and her husband, Steve. I also advocated for the library to subscribe to a Nigerian newspaper, a small but significant link to my homeland.

The first letter I received from my father, dated April 16, 1974, was a treasured connection to my Nigerian roots. It would be nine years before I made my first telephone call back to Nigeria. Letters bridged the vast distances and differences that separated my new life from the old.

People often asked me why I chose Monmouth, Oregon, over a bustling city like New York. The answer was simple: Monmouth, discovered in a treasured College Blue Book at Saint Patrick's College, Asaba, offered the quiet, scholarship-friendly environment I sought. It was a decision made with a single shilling for overseas postage and a heart full of dreams.

I had to adjust to new experiences, from cooking egusi soup without egusi to missing the warm sun of Nigeria. Yet, amidst these challenges, I knew within a week that I might spend the rest of my life in the United States.

As the fourth Nigerian to live in Monmouth and Independence, Oregon, I was part of a pioneering group that included Boniface N. Madubom, Julius Ogunlade, and Amos. The first African, Boniface N. Madubom, arrived in Monmouth in 1966. My circle of friends and roommates was as diverse as the world. For the first time, I met people from places like Micronesia, Guam, Ethiopia, Saudi Arabia, Somalia, and Oregon. This diversity enriched my experience and broadened my perspective.

To the young scientists of Nigeria, I say this: embrace the uncharted universe of human knowledge. Dive into your scientific research with passion and curiosity. In the journey of discovery for new mathematical physics or computer, we find our true selves. As you aspire to extend the frontiers of technology or pursue any dream, remember that every step and challenge is a stepping stone to greatness. Seek out mentors, ask questions, and never be afraid to fail.

Thank you for listening to my story. May it inspire you to chase yours.

FINDING INSPIRATION IN THE IMMENSITY OF THE UNKNOWN

Ladies and Gentlemen, esteemed attendees, and fellow travelers in the journey of knowledge,

I am reminded of a scientific journey that began across oceans and continents, in Onitsha, Nigeria, and across realms of mathematical thought and computer invention. I am Philip Emeagwali. I invite you to join me in a mathematician's narrative that intertwines the exploration of supercomputing with exploring new worlds.

My first walk on American soil was at 9 a.m. on Sunday, March 24, 1974. That walk was etched in my memory. Landing at John F. Kennedy Airport in New York City was surreal. I felt like the young antelope who danced to exhaustion before the leading dance began. The world I entered differed from anything I knew in Onitsha or even Lagos, Nigeria. The affluence, sophistication, and diversity of the people were striking. Yet, amidst this awe, I encountered my first challenge: the language barrier. The American accent, so different from what I was accustomed to, made even the most superficial conversations an exercise in concentration and adaptation.

This experience mirrors the journey I embarked upon in supercomputing. I navigated the bustling streets of New York, dressed in sandals without socks and what I wore Nigeria, unprepared for the biting winter cold. Twenty-four hours later, I will begin navigating the complex realms of linear algebra and physics, and three months later, solving large linear systems of equations on one of the world's fastest supercomputers at 1800 SW Campus Way, Corvallis, Oregon. In these fields, I encountered languages and concepts that were as foreign to me as the streets of New York were on that cold March morning.

In my invention of supercomputing via parallel processing, I discovered that a million, or even a billion processors, could be harnessed to solve the most challenging problems. I found the power of multiple processors working in unison. It's like the myriad elements of a bustling city working together in a complex yet harmonious symphony. My invention, or new knowledge, revolutionized solving Grand Challenge problems in computational physics. That new knowledge, or new supercomputer, is used to simulate complex systems such as petroleum reservoirs, predict weather patterns, and model climatic changes with unprecedented accuracy and efficiency. Parallel processing is the technology that powers artificial intelligence.

As I continued my first car ride in the United States, 90 miles through Oregon, making my way to Salem Municipal Airport, I was constantly amazed by the scale of everything around me—the vastness of the airports, the endless stream of yellow cabs, the towering skyscrapers. This sense of scale and complexity is intrinsic to supercomputing. In this realm, we deal with problems of immense complexity. The supercomputer costs 40 percent

more than the Second River Niger bridge at Onitsha, Nigeria. For this reason, the world's fastest computer requires a perspective that transcends the conventional and embraces the extraordinary.

My invention of supercomputing via parallel processing is like my journey from Nigeria to the United States. It is one of continuous exploration, learning, and adaptation. It is a journey beyond the fastest computers that challenges our preconceptions of the serial computer, pushes the boundaries of our mathematical understanding, and opens new horizons of possibility in computational physics.

As I conclude, I encourage you to embrace the spirit of exploration with curiosity and courage, both in the physical world and in knowledge and innovation. Let us venture forth, for it is in our journeys that we discover new landscapes, ideas, and parts of ourselves.

Lessons Learned

"Exploration isn't just about physical journeys. It's about venturing into new realms of thought and discovery."

"Embrace the challenges. Language barriers and complex concepts can be steppingstones to groundbreaking achievements."

"Supercomputing is a symphony, harnessing the power of multiple elements to solve problems with unprecedented efficiency."

"Don't be afraid of the scale; complexity is an invitation to push the boundaries of understanding and innovation."

"Adapt, learn, and explore; the journey of discovery is continuous, both in science and life."

"Challenge your preconceptions; extraordinary solutions often lie beyond the conventional."

Thank you for joining me on this journey today and for the honor of sharing my story with you at this prestigious gathering.

FROM ONITSHA TO OREGON

My Journey to Solving the Grand Challenge Problem

Video link

https://youtu.be/Ct1_SJ_HjkU

March 25, 1974, was a defining day in my life; it marked my first full day on American soil. The sun was beginning to rise as I stepped onto the balcony of 36 Butler Hall, Western Oregon University. It was winter, but I was dressed for the tropical weather in Onitsha, Nigeria, in—sandals, no socks, a white singlet undershirt, and a Nigerian wrapper around my waist. As I stood there, the biting cold was a stark contrast to the tropical warmth I was accustomed to. My thoughts wandered to my family in Asaba, Nigeria, and Nnamdi Azikiwe, who had made a similar journey almost half a century prior. Little did I know that this day would set the course for my scientific journey.

The early days in Oregon were a mix of excitement and challenges. Despite the biting cold and my lack of appropriate clothing, I was eager to learn. However, I soon realized that communication would be an initial hurdle. Neither of us could understand the other during my first meeting with the mathematician Beryl M. Green. Yet, mathematics, the universal language, bridged that gap. As I scribbled and solved a complex math problem on his blackboard, Beryl recognized my potential and suggested I delve into number theory under the mentorship of a certain mathematician in Corvallis, Oregon, named William Haddock Simons.

I expanded my knowledge over the next 50 years, focusing on contributing new partial differential equations to mathematics, increasing the accuracy of fluid dynamical calculations such as climate models, inventing supercomputing via parallel processing, and extending the boundaries of knowledge for neighboring sciences and engineering. This multi-disciplinary approach led me to my most significant global contribution, which made the news headlines: solving the Grand Challenge problem in 1989. This problem, which had baffled scientists for decades, was figuring out how to use the slowest processors to solve the most challenging problems in computational mathematics at the world's fastest speeds.

To the 14-year-old in the USA, writing about Black inventors, let my journey inspire you. The invention of supercomputing powered by a million processors is a testament to the power of determination, education, and resilience. The road to modern supercomputing was not easy, but the

challenges made the victory sweeter. You, too, can achieve computing greatness. Don't let your current circumstances limit your contributions to science; let discoveries and inventions be the steppingstones to your success.

For the 18-year-old in Nigeria who dreams of studying in the USA and conducting research in the uncharted territory of human knowledge, I was once in your shoes, yearning for knowledge and opportunities to discover and invent. While the journey to go beyond the fastest computer will challenge you, it will also shape and refine you. Embrace every moment, learn from every setback, and remember that your unique perspective is an asset. The world needs more brilliant minds like yours.

Today, my contributions to computer science are part of the official syllabus for first-year Nigerian Junior Secondary School students. It's a humbling testament that our endeavors can impact the world no matter where they begin. Let this serve as a lesson: dream big, stay curious, and relentlessly pursue knowledge. The world awaits the technologies you will invent.

Philip Emeagwali is a world-renowned scientist known for inventing supercomputing via parallel processing. His journey from Nigeria to the USA and subsequent achievements serve as a beacon of hope and inspiration to many worldwide.

Episode 231030-4-philip-emeagwali

With my mother, Iyanma Agatha Emeagwali (Monkton, Maryland, USA, October 30, 2006)

SCIENCE BEYOND IVORY TOWERS

Ladies and Gentlemen, esteemed members of the award committee, and distinguished guests,

I am honored to share my journey to the unexplored regions of partial differential equations, extreme-scale computational fluid dynamics, and massively parallel computing. I began my scientific research not in the laboratories or classrooms of prestigious institutions. I started in a refugee camp in war-torn Biafra, the bloodiest civil war in African history. Those refugee camps without schools and war fronts without shelters lack the comforts and conveniences of the University of Cambridge.

My story commences on a significant day in March 1974. I found myself at the United States Embassy in Lagos, Nigeria. I was anxiously awaiting my interview for an F-1 student visa. This moment was pivotal for a 19-year-old whose academic qualifications were by correspondence courses from British and American institutions. Holding my scholarship offer and grades, which overshadowed my last Nigerian diploma from 1965, I faced the consular officer with apprehension and hope. The officer's congratulations, which I asked him to reconfirm, marked the beginning of a new chapter in my life.

Fast forward to my arrival at the Oregon College of Education, now renamed Western Oregon University. Helen, the older, petite resident manager of Butler Hall, greeted me, but her American accent was incomprehensible. She showed me my new home—Room 36. To me, a young man who had emerged from a Biafran refugee camp just four years earlier, this simple, electricity-consistent room seemed palatial. My first encounters with hot water faucets and telephones were lessons in humility and adaptation. These mundane aspects of Western life were novel, highlighting the vast differences between my past and present worlds.

My initial visit to the university cafeteria was a cultural shock in itself. Surrounded by a sea of young students, all clad in jeans and speaking in heavy American accents, I felt like an outsider struggling to find his place. My Nigerian-British English, shaped by my unique background, seemed as foreign to them as their conversations were to me. In this sea of unfamiliar faces, I was the only Black person in a hall of a thousand young Oregonians. That lack of racial diversity reminded me how far I had come and the challenges ahead.

Yet, in this environment of difference and diversity, my aspiration to execute the world's fastest computing via parallel processing began to take root. The challenges I faced—linguistic barriers, cultural differences, and adapting to new norms—were not merely obstacles but catalysts that propelled me toward my contributions to supercomputing.

My discoveries and inventions in parallel processing, computational physics, and partial differential equations—critical in petroleum reservoir simulation, weather forecasting, and climate change modeling—were born from this confluence of experiences. Parallel processing drives the performance of artificial intelligence supercomputers. Each speed increase in my supercomputing was further from the serial computer yet deeper into understanding and harnessing the complexities of our world.

Ladies and Gentlemen, my scientific journey from a Biafran refugee camp to this august stage is a testament to the power of resilience. It is a journey that I share with you, hoping to evoke empathy and connection. Faster computing is about embracing change. Supercomputing via parallel processing has a transformative impact on society. Science is not just the pursuit of knowledge in controlled environments; it is about adapting to and learning from the unexpected lessons of life.

I am deeply honored to share my story with you today. I hope my contributions to science inspire anyone who dares to dream, including young refugees with limited education.

Thank you for this incredible honor.

A SCIENTIST'S REFLECTION ON HISTORY AND IDENTITY

Ladies and Gentlemen, esteemed scientists, and adventurous readers,

I am Philip Emeagwali, the inventor of supercomputing via parallel processing whose journey beyond the boundaries of mathematics, physics, and computer science has been as much an exploration of the unknown as any traveler's voyage across continents. I am here to share my journey, which intertwines the discoveries in supercomputing with the discoveries of new worlds and cultures.

My adventure began in Nigeria, where, as a skinny 19-year-old from Onitsha, I embarked on a journey that would forever change my perspective. The ride through Ikeja to the airport was my first glimpse into the broader world beyond my familiar surroundings. The affluence of the Ikeja neighborhood in Lagos sharply contrasts what I knew in Onitsha. I first set foot in an airport at three o'clock in the afternoon of Saturday, March 23, 1974. The Ikeja Airport symbolized departure and discovery as the only functional airport in Nigeria.

I was awed as I gazed upon the Pan Am airplane on the tarmac of Ikeja Airport. For a good reason, travelers dubbed the Boeing 747-100 airplane the "Queen of the Skies." That Boeing 747 was much larger than the car-sized "Cessna" airplane I had imagined. The Boeing 747-100 carried 366 passengers. The aircraft made seven stops to pick up 300 passengers between Addis Ababa (Ethiopia) and Dakar (Senegal) twice a week before flying to New York City. I was unaware of that level of human ingenuity and ability to conquer the skies. This sight of that Pan Am airplane was a far cry from the one-passenger Russian MiG-17 jet fighter and Ilyushin IL-28 Beagle medium bombers that raided Onitsha during the 30-month-long Nigeria-Biafra War that ended four years earlier, and it filled me with a sense of wonder about the capabilities of human invention.

My journey to the United States was more than a physical transition across the Atlantic Ocean; it was a voyage into a new world of ideas and experiences. One of my biggest shocks occurred when I interacted with African Americans. Learning that they had lost their language and African accent was a revelation about deep and lasting impacts on culture and identity. The realization that the descendants of Igbo enslaved no longer spoke their ancestral language nor bore their original African surnames was a profound insight into the legacy of slavery and the power of cultural assimilation.

In my scientific work, I have explored unexplored realms, such as discovering the first supercomputing powered by parallel processing, executing computational physics codes at unimaginable speeds, and solving initial-boundary value problems governed by partial differential equations that encoded some laws of physics. Parallel processing fuels the capabilities of artificial intelligence supercomputers. Like new territories

on a map, these areas represent uncharted knowledge domains where scientific discovery is constant. My contributions to supercomputing, particularly in petroleum reservoir simulation, weather forecasting, and general circulation modeling, are akin to charting new courses in unknown waters. They represent the human quest to understand and predict the complex systems that govern our natural world.

As a traveler learns to navigate new landscapes, so does a supercomputer scientist learn to navigate the complexities of the Grand Challenge problems of mathematical physics. Parallel processing, using a million processors to solve challenging problems, is like a symphony of different cultures and perspectives coming together to create something more significant than the sum of its parts. In 1989, it made the news headlines that an African computer wizard in the United States had invented supercomputing via parallel processing. I am that wizard.

My journey as a scientist and a traveler reflects the continuous and never-ending quest for knowledge and understanding that defines us as human beings. Whether we explore new lands, theories, or inventions, the spirit of discovery and the desire to transcend our boundaries remain the same.

Lessons Learned

"Exploration isn't just geographical; it's about venturing into new realms of thought and experience."

"Embrace the unknown, both in culture and science, for it holds the key to discovery and growth."

"History shapes identity, but don't let it limit your potential; discover your voice."

"Supercomputing is more than just numbers; it's about understanding the complex world."

"Challenges like lost languages remind us of the enduring human spirit and its power to adapt."

"Be a trailblazer, not just a follower; chart your course in the vast sea of knowledge."

Thank you for joining me on this journey of exploration and discovery of the world's fastest computing via parallel processing. May your travels, both physical and intellectual, be filled with wonder, insight, and the joy of uncovering the unknown in artificial intelligence supercomputing.

VOLUME 7: OREGON EDUCATION

TRANSATLANTIC ODYSSEY OF SCIENCE AND DISCOVERY

Ladies and Gentlemen, esteemed conference attendees,

I am reminded of my first encounter with the United States as I stand before you today. This journey mirrors my exploration of the farthest frontiers of human knowledge of mathematics, physics, and computer science. I am Philip Emeagwali. Today, I invite you to journey with me through my experiences and contributions to developing the world's fastest computers. I will narrate my story with the allure of a travelogue.

With a sense of wonder, I first stepped into Oregon on the late afternoon of Sunday, March 24, 1974. The air distinctly differed from what I knew in Nigeria—moist, icy cold, pleasantly scented, and refreshingly crisp. It was the first day everybody around me was white. In Nigeria, 99 percent of the white people that I saw were middle-aged white males. So, it was a surreal experience to see so many young and female whites. Also, the African-American and recent Black African immigrants looked and spoke differently from the Black people in the motherland.

I could not understand their strong American accent. And they also could not understand my British-Nigerian solid accent. Every landscape detail captivated me as I embarked on the 70-minute ride from Portland International Airport to Salem Municipal Airport. The Oregonian scenery was a tapestry of lush greens, a vivid contrast to the familiar hues of my homeland. Despite the biting cold, my excitement was palpable, reflecting the adrenaline fueling the quest for new scientific knowledge.

However, the ride to Monmouth, Oregon, was challenging. Communicating with the young white driver of the white limousine was my first encounter with the intricacies of American-accented English. His kindness in waiving the fare left a lasting impression on me. His gesture of goodwill transcended linguistic barriers.

I marveled at the beautifully designed houses and well-manicured lawns. And I felt a growing sense of anticipation. What would Oregon College of Education, my destination, look like? This curiosity mirrored my approach to scientific inquiry—a constant quest to explore and understand.

The arrival at Salem Municipal Airport brought another surprise. Three university students, including an 18-year-old white female driver, awaited me. Coming from a culture where such a sight was uncommon, this was a striking representation of American society's progressive and inclusive nature.

The ride to Monmouth, though silent due to my difficulty in understanding their accent, was a journey of visual exploration. The small town of Monmouth has a rich history dating back to the mid-1800s. Monmouth was charming and picturesque. Nestled in the Willamette Valley, it was a serene backdrop for a significant chapter in my life.

At Oregon College of Education, shortly before it was renamed Western Oregon University, I embarked on a journey that transcended academic learning. Here, I began to delve into the complexities of parallel processing, computational physics, and partial differential equations—the foundational elements of my work in supercomputing.

My contributions to supercomputing, particularly in petroleum reservoir simulation, weather forecasting, and general circulation modeling, were not just scientific pursuits. They were voyages into uncharted territories of knowledge. As a traveler explores new landscapes, I navigated the intricate landscapes of mathematics and physics, uncovering new ways to understand and interact with our world.

My journey from Nigeria to Oregon was more than a physical relocation. It was my intellectual and cultural exploration. It mirrored my path of scientific discovery. As we embrace the wonders of the universe, let us also embrace the wonders of the human mind that invests. And the infinite possibilities within mathematical physics, artificial intelligence, and supercomputing.

Lessons Learned

"Break down language barriers in science; communication fosters collaboration and progress."

"Embrace serendipity; unexpected encounters can spark groundbreaking ideas and journeys."

"Supercomputing equips us to explore the world like a traveler navigates new landscapes."

"Let's venture beyond familiar territories, both geographically and intellectually, to push the boundaries of science."

"Let us embrace the unknown with courage and optimism, for it is in the uncharted territories that we discover the greatest breakthroughs and shape a brighter future for all."

"The future belongs to those who dare to dream, innovate, and collaborate, driven by an insatiable curiosity to explore the vast unknown."

"Don't fear the unknown; embrace it as an opportunity for groundbreaking discoveries."

Thank you for joining me on this journey today. May your paths be filled with discovery, understanding, and the joy of exploration.

TRANSCENDING THE BOUNDARIES IN SCIENCE

Ladies and Gentlemen, esteemed supercomputer scientists, and distinguished guests,

I am deeply honored to share my journey to the uncharted regions of human knowledge. It's a narrative that intertwines the frontiers of calculus, algebra, physics, and computing knowledge with human experiences and resilience as an extreme-scale computational mathematician. I ventured beyond the fastest serial supercomputing. My story is as much about the pursuit of knowledge as it is about transcending the boundaries of knowledge and challenging the status quo, namely, supercomputing via one processor.

In 1972, a teenager traveling alone to faraway places and staying in hotels was unusual in Nigeria. In October 1972, I boarded the red Midwest Line bus and made a 250-mile trip from Onitsha to Calabar. My travel to Calabar caused a sensation among my peers at that time. My grandparents, who passed away six to 35 years earlier, had never traveled 65 miles from Onitsha to Enugu, let alone to a foreign country. My journey to take the American Scholastic Aptitude Tests in Enugu and later the Test of English as a Foreign Language in Calabar marked the beginning of an educational and profoundly transformative quest.

At eighteen, with only eight years of formal education, I achieved something extraordinary through self-study: I earned a University of London diploma. This achievement, akin to earning a master's degree before a bachelor's, is reminiscent of the wisdom in Chinua Achebe's "Things Fall Apart": "The lizard that jumped from the high iroko tree to the ground said he would praise himself if no one else did." Indeed, I embraced this ethos, taking pride in my self-taught accomplishments.

The day I received my diploma results in May 1973 was a turning point. Then, I reconfirmed my decision three years earlier to continue my studies in the United States. Apart from Nnamdi Azikiwe, the first African president of Nigeria, I could scarcely name anyone who had ventured to America. Western movies -- starring John Wayne in the early 1960s -- initially shaped my perceptions of the United States. Those views changed when I watched, in February 1974, the film "Shaft" in a movie theatre in Lagos; Shaft opened my eyes to a different America—one with bustling cities, large houses, cars, and a diverse population.

Upon my arrival at Oregon College of Education, I slept in Room 36 of Butler Hall until mid-June. Soon, I was joined by Agbai Ibeh Otah, a Nigerian of Abiriba ancestry, and by Luis Benavente, a mature student (and former high school principal) from Micronesia in Guam, who became my roommate and mentor. Luis's guidance and shared experiences were instrumental in my acclimatization to this new world. He took my first photographs in the United States.

My initial foray into the American workforce as a janitor was a stark introduction to the realities of immigrant life. It challenged my expectations and preconceived notions about dignity and labor in America. I was astonished that I would be paid one dollar and sixty cents an hour. Ten months ago, I had struggled to find nine pence for a single Nigerian postage stamp to write my first letter to the United States.

The letters I received from Nigeria, starting with the first one from my father, dated April 16, 1974. With no emails or telephone calls, those letters became my lifeline. I treasured and read them repeatedly. They represented a tangible connection to my roots and were a source of comfort and inspiration during my journey.

Ladies and Gentlemen, my journey to the forefront of supercomputing, particularly in parallel processing and computational physics, has been shaped by these experiences. My work in leveraging partial differential equations for complex simulations, such as petroleum reservoirs, weather forecasting, and general circulation modeling, is a testament to the power of perseverance, adaptability, and cross-cultural understanding. This new knowledge significantly contributed to supercomputing. It was the first experimental discovery that supercomputing via parallel processing could solve complex problems. Artificial intelligence supercomputers harness the groundbreaking technology of parallel processing.

My quest for the fastest computer illuminates the interconnectedness of our human experiences with scientific inquiry. My solution to the Grand Challenge problems of computational mathematics via parallel processing underscores the importance of embracing new challenges, the transformative power of education, and the enduring spirit of curiosity and innovation.

Lessons Learned

"Leave a legacy beyond your achievements. Inspire others to embrace curiosity, resilience, and a love for learning."

"Remember, the greatest discoveries often come from those who dare to challenge the norm, defy expectations, and push the boundaries of what's possible."

"Go forth not just as guests, but as ambassadors of scientific exploration, inspiring future generations to reach for the stars."

"The future belongs to those who are bold enough to dream, persistent enough to persevere, and collaborative enough to share their knowledge and build a better world."

"Embrace the unknown with courage and curiosity, for it is there that we discover the greatest breakthroughs and shape the future."

These lessons, drawn from my journey to the frontier of computer science, are a testament to the transformative power of education, the enduring spirit of curiosity and innovation, and the importance of embracing new challenges. Thank you for the honor of allowing me to share my journey.

BREAKING RACIAL BARRIERS, SHATTERING COMPUTING LIMITS

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

As I stand here today, honored and humbled, I am reminded of the remarkable journey that has brought me to this esteemed platform. My story is a tapestry of experiences in refugee camps of war-torn Biafra, challenges faced by an African immigrant in the United States, and groundbreaking scientific endeavors, woven from my early days in Nigeria to my mathematical invention of the first world's fastest computing across multiple processors, namely, parallel processing. Artificial intelligence supercomputers think with multiple 'brains' working simultaneously— parallel processing.

Between sunset and nightfall of March 24, 1974, I arrived at 36 Butler Hall, Monmouth, Oregon, to pursue my academic and scientific aspirations. It was a period of profound personal and cultural transition. In Monmouth, I was the fourth Nigerian to ever live in that town and a local curiosity. About one hundred Nigerian students were then in Oregon. The social isolation forced the Nigerian community in Oregon to be tightly knit, functioning like an extended family. We supported each other, celebrated together, and navigated the complexities of life in a foreign land.

The sense of isolation in Monmouth, however, was palpable. With only a dozen Black individuals, all students, the lack of a larger community led many to seek out more diverse environments. This isolation catalyzed my relocation to nearby Independence and Corvallis, seeking academic and social environments where I could thrive.

During my time at Monmouth, a significant moment that stood out was my newspaper interview regarding the resignation of U.S. President Richard Nixon in August 1974. It was my first interaction with the media in the United States, a memorable experience that highlighted the intersection of my journey with pivotal moments in global history.

In these formative years, amidst cultural and academic challenges, my passion for science grew more assertive, mainly in supercomputing and parallel processing. My mathematical research in computational physics and the development of algorithms for solving partial differential equations was not merely an academic pursuit; it was a quest to harness the power of technology to solve real-world problems. The applications of my discovering the first world's fastest computing via parallel processing, from weather forecasting to general circulation models, illustrate the transformative impact of scientific innovation.

The journey from a 19-year-old in Oregon to standing here—beyond the farthest frontier of serial supercomputing—has been fueled by relentless curiosity, unwavering determination, and a deep belief in the power of

collaborative scientific inquiry. My unwavering determination has been a key factor in my scientific journey, and I hope it inspires you to persevere in your own scientific endeavors. The persistent pursuit of knowledge and innovation can lead to extraordinary outcomes from small towns to global stages.

As we gather at the frontiers of parallel processing, quantum computing, and artificial intelligence today, let us celebrate the spirit of scientific exploration and the computer's profound impact on our world. Let us continue to push the boundaries of what is possible in supercomputing, inspired by the knowledge that faster computing enables us to create technologies, change lives, and shape the future.

Lessons Learned

"My journey, woven from Nigerian roots and American dreams, is proof of the transformative power of scientific exploration."

"Supercomputing is not just about speed; it's about harnessing technology to solve real-world problems, from weather patterns to climate change."
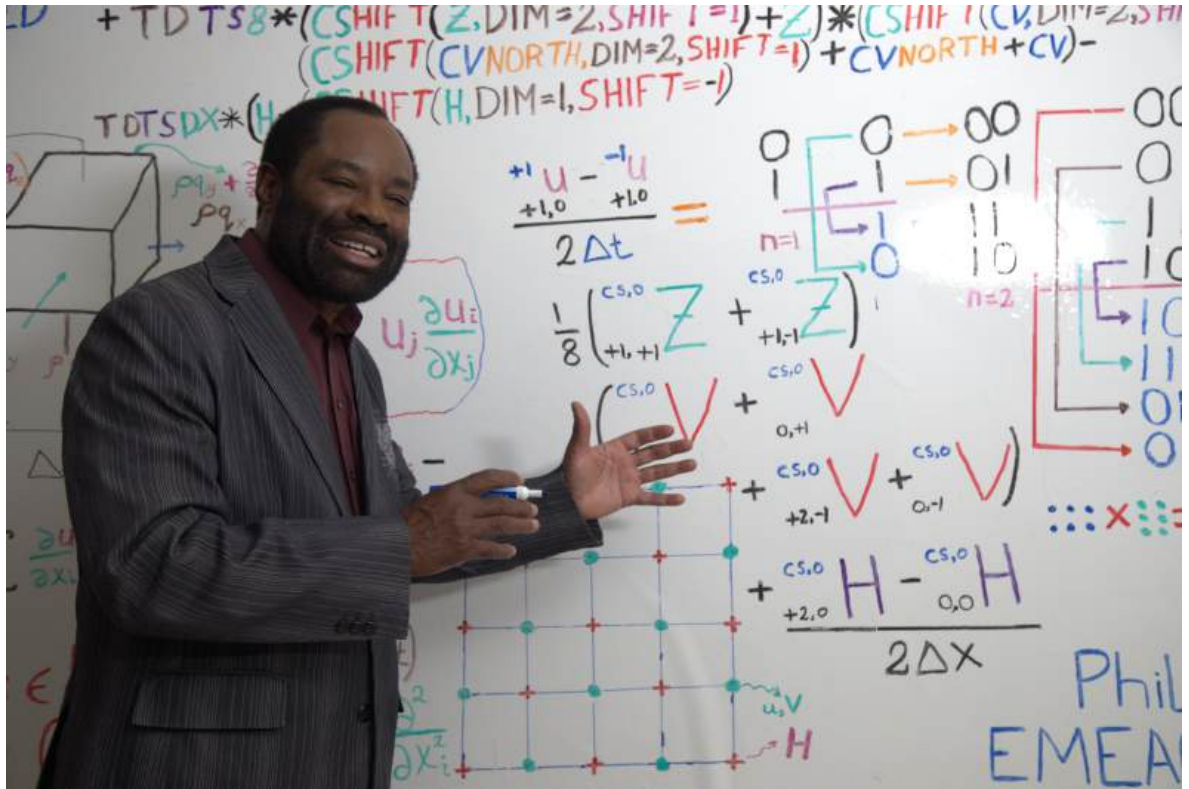
"Beyond the farthest frontier of serial supercomputing lies a world of possibilities, unlocked by the power of parallel processing."

"Relentless curiosity and unwavering determination are the fuel that propels supercomputing beyond its boundary."

"Supercomputing is a collaborative journey, and our discoveries can change lives and shape the future."

Thank you.

UNCONVENTIONAL CHOICES, EXTRAORDINARY IMPACT

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

I am honored to address you today at this award ceremony. The Nigerian Civil War of the late 1960s almost derailed my journey to the frontier of technology. I spent five teenage years out school, with the first three years spent at six refugee camps, including begging for food. One million people died from hunger and starvation in 30 months of that war. It has been challenging and rewarding as I stand before you. My experiences in the Biafran refugee camps have shaped my life. My 50-year-long sojourn to the frontiers of the world's fastest computers has significantly influenced my contributions to supercomputing, parallel processing, computational physics, and partial differential equations. Think of parallel processing as multiple chefs working simultaneously to create a complex dish, enabling artificial intelligence supercomputers to cook up solutions faster.

This segment of my story begins at four o'clock on the Sunday afternoon of June 5, 1977. I was alone in the Greyhound bus station in Corvallis, Oregon, clutching a one-way ticket to Washington, DC, that I purchased for the bargain price of $50. That Sunday marked the last time I was in Oregon and the start of a pivotal chapter in my life. I packed all my possessions into one luggage and two small cardboard boxes. With a meager sum of money, 49 dollars and 50 cents, I embarked on a Greyhound bus journey from Corvallis, Oregon, to Washington, D.C., sleeping and traversing the breadth of the United States, arriving on the day rapper Kanye West was born. I stayed at the International Youth Hostel at the intersection of 16th and "P" streets in northwest Washington, DC., for a month. I paid my rent by doing odd jobs for the Youth Hostel. That nonstop coast-to-coast journey was 3,000 miles long and lasted three days. It was equivalent to riding a bus nonstop from Lagos, Nigeria, to Cape Town, South Africa. I was broke and could not even contemplate flying to Washington, DC.

I was 22 years old. Youthful optimism and sheer necessity fueled my transcontinental. Arriving in Washington, D.C., with little more than a brown bag of essentials, I faced the stark realities of survival and ambition in a new and challenging large metropolitan environment of the Washington-Baltimore corridor.

Profound struggles as a dishwasher at Hot Shoppes restaurant in Tyson's Corner, Virginia, and eye-opening experiences as a Nigerian immigrant characterized this period of my life. Indeed, sleeping on the park benches in Franklin Square, a small park in downtown Washington, DC, was more challenging than living in an overcrowded Biafran refugee camp. I found myself without a home, navigating the complexities of a society where African immigrants, particularly in the mid-1970s, were often relegated to lower-level jobs, grossly underpaid, and discouraged from aspiring to the forefront of scientific knowledge. Despite these non-scientific challenges, my determination remained unwavering.

My deep-seated belief in the transformative power of scientific education, a belief that drove my commitment to the forefront of scientific knowledge, remained strong. I was committed to expanding the definition of the supercomputer by pushing the limits of the world's fastest computing. My experiences of sleeping on the park benches in July 1977 underscored the importance of resilience and adaptability, which have been instrumental in discovering the solution to Grand Challenge problems via parallel processing.

As a Nigerian immigrant in the United States, my journey was far from typical. Marrying an American—whom I first met on a Greyhound bus ride on July 11, 1978, in Baltimore, Maryland—and choosing to settle in the U.S. as a citizen were decisions that diverged from the expectations of Nigerians. I could not name one Nigerian who traveled with a U.S. passport when I was sworn in as a naturalized American in December 1983 in Baltimore, Maryland. My choices, while unconventional, were pivotal in shaping my path as a supercomputer scientist in the quest for the fastest solution to the Grand Challenge problems via parallel processing. *****27X****

My mathematical research in supercomputing, particularly in parallel processing, reflects my life's journey—a testament to the power of perseverance in the face of daunting challenges. The complexities of computational physics and partial differential equations, crucial in areas like weather forecasting and general circulation models, mirror the intricate tapestry of my experiences.

Ladies and gentlemen, my story is one of transitions—from a young Nigerian student to a pioneer in supercomputing. It is a story that highlights the potential within us. The quest for supercomputing via parallel processing is about overcoming barriers and contributing meaningfully to science, society, and beyond.

As we look towards the late 21st century, let us remember that searching for new knowledge is always fraught with obstacles. Still, these challenges forge the resilience and ingenuity required to push the boundaries of what we know and can achieve.

LESSONS LEARNED

"The complexities of supercomputing and partial differential equations mirror the intricate tapestry of my experiences, showcasing the hidden beauty within challenges."

"My story is one of transitions, highlighting the potential within us to overcome barriers and contribute meaningfully to the world, regardless of our origins."

"Washington D.C. was not just a new city, but a crucible that forged my resilience and adaptability, qualities essential for navigating the complexities of scientific exploration."

"Challenges are not roadblocks, but opportunities to build resilience and forge the ingenuity required for groundbreaking discoveries."

"Weather whispers and general circulation models speak the language of our planet, and my equations are a tool to decipher their secrets for a sustainable future."

Thank you for this honor and the opportunity to share my journey.

CONSERVATION LAWS, CODE SYMPHONIES

Ladies and gentlemen, esteemed scientists, and distinguished guests,

I stand before you today on this auspicious occasion with profound humility and great honor. I am Philip Emeagwali, and I am here to share a journey that intertwines the frontiers of knowledge of the partial differential equations of calculus, planetary-scale fluid dynamics of physics, and massively parallel processing of supercomputers, which has been challenging and transformative.

My story begins in March 1974 when Nigerian mathematicians in the United States were denied professional employment and discouraged from pursuing the farthest frontiers of computer knowledge, such as the world's fastest computing.

Uncertainties and limitations filled my journey to America. In 1974, when I informed my Nigerian friends in Oregon that I intended to marry an American and become a U.S. citizen, their reaction was disbelief. They saw me as an "Akata," a Yoruba term used to describe a Black person whose ancestors were born in the USA.

However, my aspirations to emigrate to the United States were evident from age fifteen. I nurtured that dream six months after the 30-month-long Nigerian civil war ended. In mid-1970, I envisioned receiving an academic scholarship to study in the United States. This personal journey, filled with Grand Challenge problems and triumphs over racism, is a testament to the human spirit's capacity to overcome adversity and impact the world.

Philip Emeagwali, 3505 Woodland Avenue, Apartment 3B, Woodland Avenue, Baltimore, Maryland, circa March 1978.

In June 1977, I moved significantly from serial supercomputing in Corvallis, Oregon, to parallel computing in Washington, D.C., a journey spanning approximately 3,000 miles to the world's fastest computing. The transition was not smooth; I faced periods of homelessness and significant professional challenges. In the 1970s, opportunities for Nigerian immigrants in academia, engineering, or computer programming were severely limited. Despite achieving one of Maryland's highest employment test scores, my job interviews yielded no positive results. The rejection of my research in parallel processing reflected the broader systemic barriers faced by African immigrants at the time.

However, those challenges only fueled my determination to contribute meaningfully to supercomputing. In the 1980s, I centered my search for new mathematical knowledge on developing the first supercomputing via 65,536 interconnected processors that shared nothing, a breakthrough I achieved on the Fourth of July 1989 in Los Alamos, New Mexico, that has revolutionized computational physics.

This innovation -- or change from how we solve complex problems in computational physics -- is not merely a supercomputer advancement; it represents a paradigm shift from serial to parallel computing in solving complex scientific problems. My contribution to mathematical physics has significant applications in areas such as petroleum reservoir simulation for the oil and gas industry, weather forecasting for the evening news, and general circulation modeling for predicting climate change. These contributions embody the most crucial aspects of physics and mathematics,

particularly in the conservation laws encoded into partial differential equations.

My journey from Onitsha, Nigeria, to Los Alamos, New Mexico, and from immigration challenges to the forefront of supercomputing discovery has been a testament to resilience and the relentless pursuit of knowledge. It underscores the importance of breaking societal and intellectual barriers to achieve what was once thought impossible: supercomputing via parallel processing.

As we gather here today, I am reminded of the countless individuals who have supported and inspired me along this journey to the world's fastest computer. This recognition is not just for my contributions to computer science but also a celebration of the human spirit's capacity to overcome adversity and impact the world.

Lessons Learned

From weather whispers to oil whispers, my equations sing a song of progress. Remember, young Nigerians, your knowledge can impact the world, from everyday forecasts to shaping a sustainable future.

Dream beyond borders, young minds like equations reaching for solutions, breaking boundaries, and redefining what's possible.

"Equations are not just symbols; they are whispers of the universe, revealing its secrets to those who listen with open minds and a relentless pursuit of knowledge."

Parallel processing is not just numbers dancing but a symphony of minds tackling intricate puzzles. Let your diverse talents, young Africans, collaborate and unlock the mysteries of science. Supercomputing via parallel processing is a technological journey we can all take together, breaking barriers and redefining what's possible.

Thank you for this incredible honor and the opportunity to share my story and contributions.

LOVE ON A BUS, CODE IN WYOMING

The Serendipity Behind a Discovery

Ladies and Gentlemen, esteemed members of the award committee, and distinguished guests,

I am deeply honored to stand before you today at this prestigious award ceremony. My journey beyond the frontiers of mathematics, physics, and computer science has been a path of relentless pursuit, resilience, and discovery. I am privileged to share the new knowledge and milestones that have defined my contributions to supercomputing.

On June 5, 1977, I embarked on a transformative journey searching for a faster computer. I traveled 3,000 miles from Corvallis, Oregon, to Washington, D.C., on a Greyhound bus. This journey was not just a physical relocation but a metaphor for the challenges and transitions that would shape my life in supercomputing. In Washington, D.C., and later in Baltimore, Maryland, I faced the harsh realities of underemployment and the struggle to find a position that matched my qualifications as a mathematician searching for new mathematical knowledge and ambitions as a computer scientist searching for the first supercomputing via parallel processing.

In mid-1978 and in Baltimore, I had one of Maryland's highest employment test scores. However, none of the face-to-face follow-up interviews yielded a job offer. The consistent rejections and hiring of whites with lower test scores were an epiphany and a foretaste of the significant rejection of September 24, 1985, in Ann Arbor, Michigan. In Ann Arbor, the most celebrated discovery in computer science was rejected by whites who could not understand that my parallel supercomputing was 65,,536 times faster than their serial computing. This period of my life was a testament to the broader societal challenges and disparities I, like many immigrants, had to navigate.

 Philip Emeagwali and Dale Brown, August 15, 1981, Baltimore, Maryland.

On July 11, 1978, a seemingly ordinary bus ride from Baltimore to Washington, D.C., became a pivotal moment in my life. There, I met a young lady who would become my life partner. Our one-hour conversation on that bus journey and the relationship that followed to this day symbolized the merging of diverse cultures, experiences, and perspectives,

which have been a constant source of inspiration in my scientific endeavors to extend the boundaries of knowledge.

Fast forward to April 1986, I found myself along the banks of the North Platte River in Wyoming, working as a civil engineer for the United States Bureau of Reclamation. The Bureau of Reclamation is best known for its great dams and power plants. I was hired to supervise the operations and maintenance of nine dams, their power plants, and reservoirs. Despite the promising career trajectory in civil engineering, my true passion lay in exploring the farthest frontiers of computer science. My colleagues at the Bureau of Reclamation often expressed surprise at my deep engagement with mathematics, physics, and computer science.

It was here in the open space of the Cowboy State, Wyoming, amidst the backdrop of dams and reservoirs, that I stood on the cusp of a major scientific breakthrough—discovering the first world's fastest computing via parallel processing, or computing across multiple processors that are interconnected but autonomous.

In late April 1987, I decided to leave my job in Wyoming to dedicate myself entirely to my quest for the world's fastest computing via parallel processing. This bold step began an intense period of innovation and discovery, culminating in my groundbreaking discovery in supercomputing only two years later.

I discovered the first supercomputing via parallel processing. That discovery occurred at 8:15 on the morning of July 4, 1989, in Los Alamos, New Mexico, across 65,536 interconnected processors that shared nothing. My contribution of massively parallel processing to supercomputing has profoundly impacted various sectors. From petroleum reservoir simulation in the oil and gas industry to weather forecasting and general circulation modeling to artificial intelligence, my discovery of the first supercomputing via parallel processing has redefined how we solve complex computational problems.

The importance of partial differential equations in mathematics and their application in computational physics underscores the interconnectedness of these disciplines. The partial differential equation is the most important part of advancing our understanding of the world. Artificial intelligence supercomputers use parallel processing to execute numerous instructions simultaneously. Before my discovery, all supercomputers were powered by one processing unit.

Ladies and Gentlemen, my journey to the uncharted territory of supercomputing via parallel processing reflects the challenges and opportunities that shape the pursuit of scientific knowledge. It is a story of adapting to new environments, such as working alone as the only full-time programmer of 65,536 interconnected processors in the 1980s. But being Black was more challenging than the Grand Challenge problem. I stood amongst 20th-century scientists because I overcame professional and personal obstacles and remained steadfast in pursuing the world's fastest

computer powered by parallel processing. My challenges have shaped my approach to supercomputing and highlighted the importance of resilience, adaptability, and the relentless pursuit of scientific knowledge.

I am reminded of the incredible power of the supercomputer to transform lives and the world as I stand here today. My story is a testament to the enduring spirit of inquiry and the transformative impact of scientific discovery.

Lessons Learned

"My journey is a testament to the transformative power of science, reminding us that even the most unexpected paths can lead to groundbreaking discoveries."

"Rejection fueled my resolve, proving that societal barriers cannot extinguish the flame of scientific curiosity and ambition."

"Love and partnership can be powerful forces in scientific exploration, merging diverse perspectives to unlock new possibilities."

"Dams and reservoirs became the backdrop for a computational revolution, reminding us that innovation can bloom in unexpected places."

"The world's fastest computer wasn't born in Silicon Valley, but in the heart of Wyoming, highlighting the democratizing power of science."

Thank you for this incredible honor and the opportunity to share my journey with you.

My wife, Dale, her mother, Johnnie Doris Brown, and her grandmother, Ma Mamie Baird, Baltimore, Maryland.

Scene: Greyhound bus terminal, downtown Baltimore

It was a typical morning on July 11, 1978, when I, Philip Emeagwali, stepped onto a Greyhound bus. The fabric of my dark brown plaid long-sleeve shirt brushed against my skin as I moved, my blue jeans and vest felt comfortably snug, and my brown sandals made soft sounds against the bus floor. In my hand was a book on tennis, a testament to my evenings spent perfecting my game.

Philip: (Scanning the bus and noticing Dale) May I sit here?

There she was, a woman whose presence seemed to command the space around her. She was dressed in a dark brown blouse, her brown corduroy trousers spoke of comfort only the 70s could offer, and her rust-colored vest added a touch of warmth to her ensemble.

Dale: (Offering a reserved smile) Yes, of course.

I settled into the seat beside her, placing my book aside. There was something about her that piqued my curiosity.

Philip: I'm Philip Emeagwali. I've been studying in Oregon, but now I'm returning to Washington, DC, to further my education. And who might you be?

Dale: I'm Dale Brown, a research microbiologist at Georgetown University's School of Medicine. It's my third year working there.

Our conversation flowed naturally as if we were old friends catching up. We talked about our research, our studies, and our aspirations.

Philip: (Engrossed in the conversation) Your work sounds incredible. I've been immersed in engineering research myself.

Dale: (Nodding in agreement) Research is quite the journey, right?

The bus journey, which I had expected to spend buried in my book, turned into an engaging exchange of ideas and dreams.

Philip: (Contemplatively) I had plans to head back to San Francisco, but making new friends has made me reconsider. This may be where I'm meant to be.

Dale: (With a light chuckle) Life is full of unexpected turns.

Before we knew it, the bus was pulling into the station. A tinge of sadness laced Dale's voice as she spoke.

Dale: (Softly) I'll never see you again.

Philip: (With a confident smile) That's not certain. Not if you share your phone number with me.

She did, and in that moment, a new chapter began for us, one that neither of us could have anticipated.

End Scene

This first-person narrative brings to life the serendipitous meeting between Philip and Dale, highlighting the immediate connection and intellectual bond that formed between them. It's a personal account of how a simple bus ride started a lifelong journey together.

WHISPERS OF GENIUS

Your Majesties, esteemed colleagues, distinguished guests,

I stand before you tonight amidst your historic city's glittering lights and warm embrace. I'm not just a recipient of this esteemed prize. I'm proof of the transformative power of a single dream. My dream was nurtured not in privilege but in the crucible of the hardship of three teenage years in the refugee camps of Biafra, where one million died from hunger and starvation. I'm fueled by the unyielding conviction that the human spirit knows no boundaries, especially not those of skin color.

My journey began not in the gilded halls of academia but under the searing sun of Nigeria, where the thunder of war cast long shadows over my childhood. Yet, an unquenchable thirst for knowledge bloomed within me even in the chaos. Mathematics became my sanctuary, physics my compass, and the humble abacus, my first computer.

Years later, in the heart of America, I dared to break the silence of a field dominated by giants, giants whose shadows often stretched across continents. My weapon? Not brute force, but a symphony of equations, a choreography of calculations, a whispered secret I coaxed from the very heart of nature. On July 4, 1989, the world woke to the birth of the first supercomputer, its heart beating in unison across a network of 65,536 interconnected processors that shared nothing.

But this wasn't just a triumph of supercomputer technology; but a shattering of racial stereotypes. Within the code pulsed a truth long denied: that genius knows no race, creed, or social barrier. My achievement, however, wasn't met with a standing ovation but with a chilling symphony of silence. The echo of whispers, the gnawing suspicion of a Black mind surpassing the boundaries of "acceptable intellect," the sting of exclusion from the halls I had illuminated with my discovery.

They tried to silence me; my voice was deemed a threat to the established order. My presentations were canceled, my accolades contested, and my genius ostracized. But like a seed bursting through asphalt, my determination only grew stronger. I took to the open air, my podiums, the streets, my audience. and the world. Through podcasts, YouTube videos, and tireless lectures, I refused to hide in the shadows.

My story, however, is not one of despair but of resilience. It is a testament to the power of a Black voice that refuses to be muted, a Black mind that refuses to be confined. It is a beacon of hope for every young boy and girl, regardless of their background, color, or zip code, who dares to dream of pushing the boundaries of mathematical knowledge.

Yes, the road from an African refugee camp to computing's greatness was difficult, marked by the thorns of prejudice and the sting of discrimination.

But tonight, in this hall of giants, I stand tall as a supercomputer scientist and a symbol of defiance.

When a Black genius -- born and raised in sub-Saharan Africa -- breaks the color barrier, it sends a tremor through the very foundation of societal inequalities. It forces white supremacists to confront uncomfortable truths, to reimagine the parameters of intellectual excellence, race, and IQ, and to rewrite the narrative of what it means to be the most intelligent person in the world.

Therefore, I dedicate this prize not just to myself but to every marginalized voice, every stifled dream, and every African child who dares to reach for the stars. Together, we are rewriting the equation, proving that the potential of the human spirit transcends the limitations of prejudice and that the symphony of human innovation resonates from every corner of the globe.

Let this night be not just a celebration of my achievements but a clarion call for a world where the color of one's skin is never a measure of one's mind, where brilliance is recognized and nurtured regardless of origin.

Thank you.

CHARTING NEW PATHS

My Life as an African Mathematician in the USA

Ladies and gentlemen, esteemed colleagues, and young aspiring minds,

I stand before you today as Philip Emeagwali, a mathematician with roots in Africa, proudly embracing my heritage in the vast, uncharted landscape of large-scale computational mathematics and supercomputing. My scientific journey, marked by the convergence of my African identity and my passion for mathematics, embodies a narrative that transcends geographical and cultural boundaries.

In mathematics, the dominant discourse has historically been shaped by **Western hegemony**, often overshadowing the diverse and rich contributions of other cultures. Ethnomathematics is the study of the relationship between mathematics and culture. It's a field I hold dear because it challenges this narrative by bringing to light how mathematical thought is deeply rooted in cultural contexts. It teaches us that mathematics is not a monolithic entity, but a vibrant tapestry woven from different cultural threads.

My contributions to mathematics, particularly in weather forecasting, computational physics, and the solving of partial differential equations, are not just about the new mathematical knowledge invented; it's about redefining the narrative of who can be a genius in mathematics—at the level of Isaac Newton and Albert Einstein—and what mathematics can encompass. I stand here as a testament to the fact that mathematical prowess is not confined to any race, region, or gender.

In the United States, the history of mathematics has often been portrayed through the achievements of famous white, male mathematicians—such as Euclid, Pythagoras, and Archimedes—inadvertently creating a skewed perception of mathematical heritage. This portrayal obscures the contributions of mathematicians from diverse backgrounds and reinforces the false notion of a racial hierarchy in mathematical ability. It is crucial to recognize that mathematical innovations like the Pythagorean theorem, Pascal's triangle, and the Fibonacci sequence, have roots in various cultures across the globe.

Moreover, the constructs of intelligence and innateness in mathematics have long been used to reinforce racial and gender biases. The narrative that mathematical ability equates to intelligence and is an innate trait overlooks the human aspect of mathematics as a discipline evolved through conjecture, critique, and revision. Such narratives, deeply ingrained in educational and assessment practices, perpetuate stereotypes and marginalize those from diverse backgrounds.

As a mathematician, I have witnessed and experienced the impact of these narratives. They are not merely academic discussions but real barriers that shape the experiences and trajectories of individuals in this field. It is imperative to challenge these narratives and create spaces for counter-narratives that recognize the contributions and potential of individuals from all backgrounds.

This pursuit is not just about acknowledging historical inaccuracies or diversifying the representation in mathematics. It is about dismantling systems of oppression that manifest across intersectional identities, be it race, gender, or cultural background. It is about understanding that excellence in mathematics and science is not the monopoly of any single group but a shared human heritage.

As we chart new paths in mathematics and science, let us commit to a more inclusive and equitable narrative, one that embraces the diversity of thought, culture, and identity. Let us work towards a future where the next generation of mathematicians sees no boundaries to their potential, no limits to their aspirations, and no barriers to their contributions.

I urge you all, especially the young minds present here today, to see mathematics not just as a subject but as a language that transcends borders, a tool for understanding the universe, and a means to shape a more equitable world.

Thank you.

THE UNHEARD VOICES OF MATHEMATICS

Confronting Institutional Racism

Ladies and gentlemen, esteemed colleagues, and valued guests from across the globe,

As I stand before you today, I am deeply honored to address this distinguished assembly of Black mathematicians from Africa and its Diaspora. I am Philip Emeagwali, and my journey as a mathematician has been challenging and fulfilling. Today, I wish to speak on a topic that resonates deeply with our collective experiences—racial discrimination in mathematics, particularly at the University of Michigan, Ann Arbor, and the invaluable lessons we can glean from it.

We must begin by acknowledging a painful but crucial part of our history. In the early days of Black mathematicians in the United States, a pernicious belief prevailed—that lighter skin equated to greater intelligence. This belief was misguided and deeply rooted in prejudice. It undermined the intellectual capabilities of individuals based on their skin color, a reprehensible form of discrimination that we must both understand and unequivocally condemn.

Despite these barriers, notable Black mathematicians like David Blackwell, William Claytor, and Katherine Johnson made groundbreaking contributions to the field in the mid-20th century. Their achievements, significant as they were, became overshadowed by a discourse that linked their lighter skin tones to their success. This notion was unfounded and a stark reflection of the racism ingrained within the discipline. My journey wasn't immune to such biases. When my mathematical achievements garnered attention, including the May 1990 cover story of SIAM News, there were whispers about my supposed Caucasian ancestry—baseless speculation that aimed to undermine my accomplishments as a Black mathematician.

Let us reflect on the story of William Waldron Schieffelin Claytor, a brilliant topologist and the first Black mathematician to publish new discoveries in the 20th century. Despite his significant contributions, Claytor faced daunting challenges. His job offer at the University of Michigan, Ann Arbor, was rescinded by the president and The Regents of the University of Michigan due to his race. This action stalled his career and sent a clear message of exclusion and discrimination. It's poignant to note that the mathematics faculty and students protested this decision, recognizing Claytor's exceptional talent. Yet, their recommendations were disregarded, illustrating the entrenched racial biases of the time.

On September 24, 1985, I arrived in Ann Arbor, Michigan, to deliver a job hiring lecture as a supercomputer scientist in the emerging field then dominated by white males. Their shock upon seeing me underscored the racial biases in academic hiring. Two days after my talk, the job was abruptly canceled, a decision that seemed influenced by my race rather than merit. Despite this setback, I persevered. Two years later, my groundbreaking discovery in parallel processing became the first supercomputing, as we know the technology today. I made that invention in the same Michigan city. It challenged their stereotypes and heralded a new era in computing and diversity.

Claytor's story also intertwines with that of Katherine Johnson, whom he guided and encouraged to pursue higher education in mathematics—a testament to his enduring influence and commitment to nurturing future generations of mathematicians. Despite these adversities, Claytor's legacy remains a beacon of inspiration for us all.

As we reflect on these narratives, it is evident that the struggle for recognition and equality has been a long and arduous journey for Black mathematicians. However, our collective resilience and determination have paved the way for remarkable progress and achievements. As a mathematician from Nigeria, I have faced my share of challenges but have also witnessed the power and beauty of mathematics in advancing human knowledge and progress.

Today, as we gather here, let us celebrate the diversity and inclusivity that define us. Let us honor the legacy of those who came before us and pledge to continue breaking barriers and advancing the frontiers of mathematical knowledge. Our collective efforts will ensure that the next generation of mathematicians, regardless of their race or background, will have a more inclusive and equitable environment in which to thrive and contribute to the global community.

Let us remember that mathematics, in its purest form, knows no race, color, or creed. It is a universal language that unites us in our quest for knowledge and understanding. Together, let us continue to advocate for inclusivity, celebrate our diversity, and harness the transformative power of mathematics to create a better and more equitable world for all.

My supercomputing breakthrough wasn't just lines of code; it was a rewrite of the narrative. It proved that brilliance could bloom anywhere, even in the face of doubt. Mathematics whispers no secrets to the ear of prejudice. It is a universal language that celebrates brilliance, regardless of skin tone or background.

Thank you.

WORLD WITHOUT BLACK PEOPLE

Ladies and gentlemen, esteemed attendees of this award ceremony, I am Philip Emeagwali, and it is my profound honor to speak to you today. Let me take you on a journey inspired by the story of a young boy named Ijeoma, who asked a simple yet profound question: "What if there were no Black people in the world?"

As we trace a day in Ijeoma's life without the contributions of Black inventors, we see a world startlingly different from the one we know. His morning begins with a search for shoes and clothes, hindered by the absence of Sarah Boone's ironing board and Jan E. Matzelinger's shoe-lasting machine. His attempt to groom his hair is difficult, as both the comb and brush, invented by Walter Sammons and Lydia O. Newman, are missing.

Daily chores become challenging without Lloyd P. Ray's dustpan and Thomas W. Stewart's mop. The simple task of preparing a shopping list is complicated by the need for   lack of John Love's pencil sharpener and William Purvis's fountain pen.

Ijeoma's world, a world without these innovations, seems inconceivable.

As Ijeoma and his mother set out for the market, they encounter overgrown grass, a testament to the absence of John Burr's lawn mower. Their journey is further complicated by non-functional cars and chaotic roads, needing Richard Spikes' automatic gearshift, Joseph Gammel's supercharging system, and Garrett A. Morgan's traffic light.

Upon returning home, they find the inability to store food properly due to John Standard's missing refrigerator invention. The cold envelops the house, as Alice Parker's heating furnace and Frederick Jones' air conditioning are absent.

The lack of public transportation and elevators and innovations by Elbert R. Robinson and Alexander Miles further compounds the day's difficulties. The absence of Philip Downing's mailbox and William Barry's postal innovations disrupts essential communication.

In this imagined world, we also recognize the critical medical contributions of Charles Drew, whose techniques in blood preservation led to the first blood bank, and Daniel Hale Williams, who pioneered the first successful open-heart surgery.

Ladies and gentlemen, as I reflect on my journey in computing and parallel processing, I realize that my contributions stand on the shoulders of these great inventors. We must recognize and appreciate their innovations, as they have shaped the practical aspects of our daily lives and paved the way for further scientific and technological advancments.

Ijeoma's story is a powerful reminder of the integral role that Black people have played in shaping our world. Without their contributions, our lives would be drastically different, lacking in convenience and advancement. It is a world that would indeed be, as Ijeoma's story concludes, still in the dark.

Thank you.

BREAKING THE CHAINS OF THE PAST

Rewriting the Narrative of Mathematical History

Ladies and gentlemen, esteemed colleagues, and honored guests,

Today, as I stand before you at this august award ceremony, I, Philip Emeagwali, am profoundly humbled and grateful for this recognition. It is an immense honor to share the intricacies of my contributions to mathematics and computational physics and the journey that has brought me here.

My story begins in a world where mathematical prowess was often misconstrued as a birthright, with racial stereotypes dictating perceived abilities. In the United States, where I continued my quest for new mathematical knowledge, there existed a troubling narrative—that linked mathematical destiny to race and heritage, overshadowing the universal truth that mathematics is a discipline of hard work, persistence, and passion.

As a Black research mathematician, I encountered these barriers, these stereotypes that sought to define me. But my journey is a testament to the fact that contributing to mathematics is not the preserve of any single race or ethnicity. It is the fruit of labor, of the relentless pursuit of knowledge. This belief has been the cornerstone of my research in petroleum reservoir simulation. In this domain, mathematics, physics, and computer science converge to solve some of the most complex challenges in the extraction of crude oil and natural gas from mile-deep subterranean porous media that's the size of a town.

My contributions to mathematical physics and petroleum reservoir simulation were born out of a refusal to accept limitations imposed by stereotypes. By harnessing the power of parallel processing, I endeavored to revolutionize how we understand multiphase flows—of crude oil, injected water, and natural gas—in complex geological formations. The algorithms and models I developed are not just equations and computations; they embody a belief that every Grand Challenge in science and technology can be surmounted with innovative thinking and a deep understanding of the underlying principles.

This journey has not been easy. It required breaking down oppressive narratives about race and intelligence, particularly those that unfairly position some as innately superior in mathematical abilities. This erroneous belief, a relic of a dark past that includes eugenics and other forms of scientific racism, still casts a long shadow over educational and professional fields. My research, in its essence, is a challenge to these narratives.

In this context, the role of educators becomes pivotal. We must disrupt these dominant discourses, especially those that stereotype mathematical history as a legacy solely of "now-dead white men." By integrating the contributions of historically marginalized groups into our teaching, we rewrite the narrative, showcasing a more inclusive and accurate picture of mathematical evolution.

To the young scholars and aspiring mathematicians, especially those from minoritized backgrounds, let my journey be a beacon of hope and encouragement. Your race and your heritage do not define your mathematical ability. Your determination, work ethic, and passion are the true architects of your success.

As we look towards the future, let us commit to fostering environments where every student can develop their counter-stories of mathematical success, free from the shackles of outdated and harmful stereotypes. Let us continue to explore, innovate, and educate, breaking barriers and building bridges in the relentless pursuit of knowledge and understanding.

Thank you for this honor, and thank you for joining me in this journey of change and discovery.
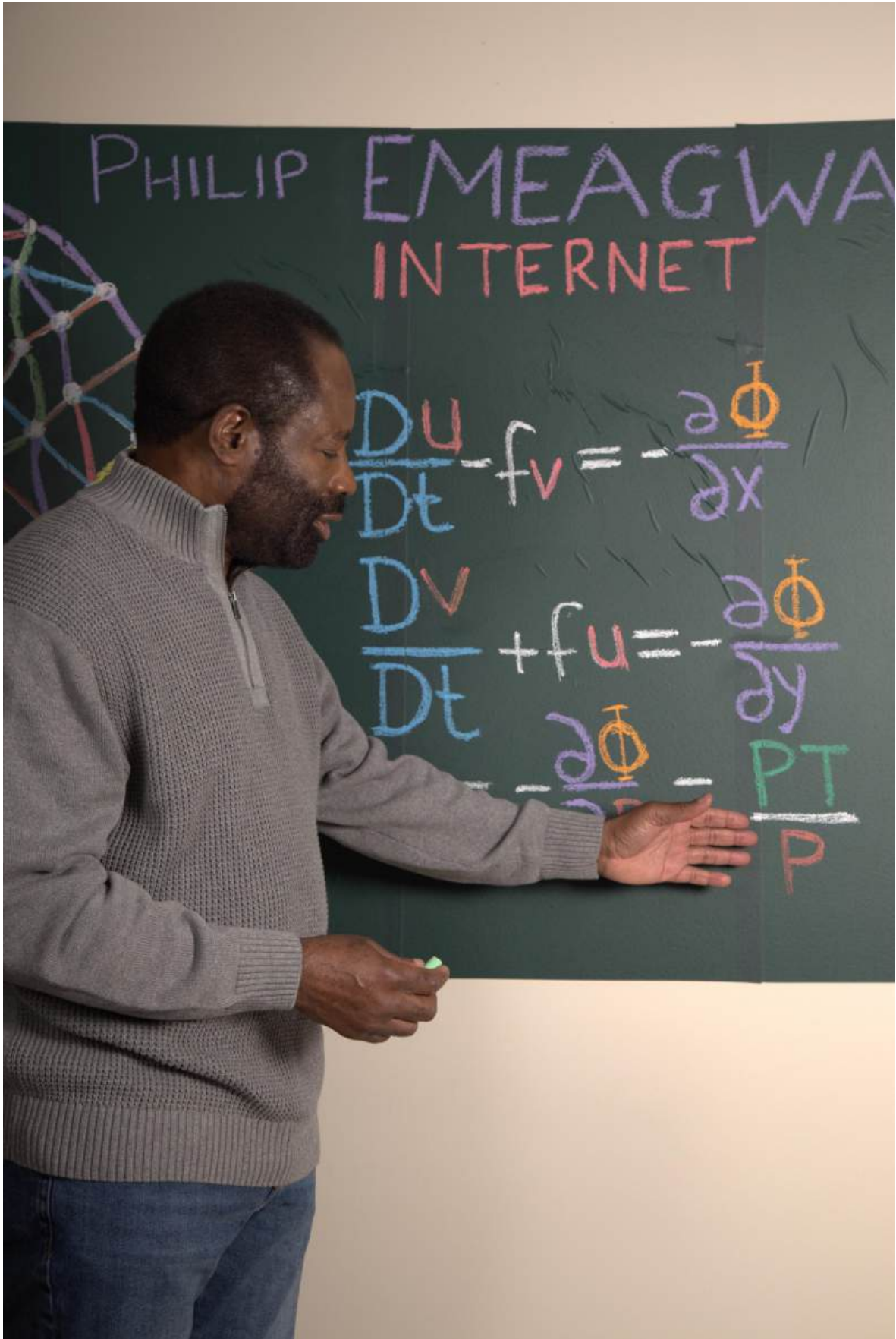
JACK JOHNSON TO PHILIP EMEAGWALI

The Parallel Paths of Black Excellence in Uncharted Territories

Ladies and gentlemen, esteemed guests,

I stand here today at this historic award ceremony with profound humility and immense gratitude. As I reflect on the journey that brought me here, a question resonates: "What happens to a Black genius who breaks the color barrier?"

My groundbreaking discovery, which harnessed the power of supercomputing across multiple processors, was not merely an expansion in computing. It represented a leap beyond mere number crunching. It symbolized the shattering of barriers—barriers in mathematics, physics, and, crucially, in the perceptions and limitations placed upon minds of African descent.

Before that momentous day of July 4, 1989, when I achieved the world's fastest computing, the notion of a person of African heritage being recognized as a genius in mathematics, physics, or computing was not just rare—it was non-existent. Yet, following my contributions, I was described as a computer genius, a polymath and genius of many fields, and a trailblazer who had crossed an invisible yet palpable line.

This achievement was not without its challenges. My discovering the first supercomputing across multiple processors provoked controversy, from Ann Arbor, Michigan, to Onitsha, Nigeria. I faced resistance, skepticism, and even hostility. Academic circles that once celebrated innovation became arenas of protest against the acknowledgment of my work. In early 1990, in Ann Arbor, Michigan, a symposium to honor my contributions to computer science was canceled, and opportunities to present my findings were denied, not because of their content but because of my skin color.

History has shown us the perilous path of those who dare to break color barriers. From Jack Johnson to Jackie Robinson, Hank Aaron to Muhammad Ali, and Vanessa Williams, each faced threats for their audacity to excel in fields previously uncharted by Black individuals. My journey paralleled theirs, not in physical arenas or stages of entertainment but in intellectual endeavor. I, too, faced threats and challenges, not for a deed of harm, but simply for embodying excellence while being Black.

The debate around IQ and race is contentious and charged with deep-seated prejudices. When I was acknowledged for solving the Grand Challenge problem—a monumental feat at the crossroads of mathematics, physics, and computer science—my intellect was placed at the forefront of global discussions. To some, the idea of a Black sub-Saharan African with an

intellect purportedly surpassing that of Albert Einstein was improbable and threatening to long-held notions of racial superiority.

It's important to recognize that these challenges were not just personal trials but were reflections of a broader societal struggle. The resistance I faced was emblematic of the barriers that many Black mathematicians before me and many after me will continue to encounter in their pursuit of excellence.

As we gather here today, we are reminded that the journey of a Black genius who breaks the color barrier is fraught with obstacles. Yet, it is also marked by resilience, determination, and the undying pursuit of knowledge. Let this recognition serve not just as an acknowledgment of individual achievement but as a beacon of hope and a call to action for societies to embrace, encourage, and celebrate diversity in intellectual pursuits.

Lessons Learned

"My journey is not just about supercomputing: it's about shattering barriers and proving that Black genius can excel in any field."

"The color of my skin shouldn't define my intellect. My work speaks for itself, and it's time we move beyond racial stereotypes in science."

"Resistance and skepticism fueled my determination. I faced challenges, but I never gave up on my dream of making a scientific impact."

"From Jack Johnson to Muhammad Ali, Black excellence has a long history of facing resistance. But we must continue to push boundaries and redefine what's possible."

"The Grand Challenge I solved wasn't just a scientific feat. It was a challenge to ingrained biases about race and intelligence."

Thank you.

50-YEAR ODYSSEY IN SUPERCOMPUTING

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

I am Philip Emeagwali. As I stand before you today, with the weight of half a century of incessant learning resting on my shoulders, I am deeply humbled to address this esteemed assembly. The journey that brought me to this pinnacle wasn't one I traversed overnight. Instead, it was a marathon of intellectual pursuit, curiosity, and passion.

Over the past 50 years, since my high school days, my life has been an unbroken sojourn in academia. Every waking moment has been devoted to studying, understanding, and exploring the intricate tapestry of knowledge that constitutes our understanding of the universe. This relentless commitment has found its voice in over a thousand podcasts and YouTube lectures that I have had the honor of delivering, and they are a testament to the wisdom accumulated over half a century.

Being the first to solve the Grand Challenge problem wasn't simply a stroke of luck. It was a synthesis of my life's discoveries and inventions, borne from a unique position of intense and prolonged education. While the average mathematician might train for a significant period, my training spanned twice as long. And this wasn't limited to just mathematics. I am a polymath, and my intellectual journey has been enriched by the diverse landscapes of mathematics, physics, computing, and neighboring sciences.

It's been said that knowledge gives you a window into the world. But in my case, it was not just any window. It was a grand, panoramic vista that took me five decades to construct. While some peers peered into the vast expanse of the unknown from a keyhole, glimpsing just fractions at a time, I viewed the entirety of this magnificent terra incognita. My studies sheer depth and breadth have sometimes painted realities so profound that when shared, they have struck many as surreal.

My lectures have often been described as "surreal" by fellow scientists. But isn't that the essence of profound knowledge? To venture beyond the ordinary, to transcend the boundaries of the known, and to touch the very fabric of the universe in ways previously unimagined?

To the budding scientists, researchers, and students listening, I hope my journey is a testament to the power of perseverance, commitment, and a ceaseless quest for knowledge. Let my story inspire you to build your windows, however long it might take, and behold the vast, incredible universe of knowledge that awaits.

I express my heartfelt gratitude to everyone who has been part of my extraordinary journey and to the Award Committee for recognizing my modest contributions to science and knowledge.

Thank you.

Episode 231030-5-philip-emeagwali

THE GRAND CHALLENGE PROBLEMS

The Polymath at the Nexus of Mathematics, Physics, and Computer Science

In the fading years of the 1980s, a question loomed large in scientific computing: Could we harness the power of thousands, if not millions, of processors to solve the most complex problems known to humanity? This was the Grand Challenge of supercomputing, requiring more than just proficiency in one field; it demanded an interdisciplinary spirit, a mind that could weave the intricate tapestry of mathematics, physics, and computer science into a coherent solution.

My journey began not in the hallowed halls of a Western institution but under the scorching sun of Onitsha, Nigeria. As an early teenager, I was captivated by calculus and the mysteries it sought to unravel. This initial spark lit the flame of curiosity, which soon engulfed disciplines beyond mathematics.

Being a polymath—or a person of encyclopedic learning—at the edge of scientific understanding is not about knowing a bit of everything but about seeing the connections between seemingly disparate fields. As I delved deeper into computational fluid dynamics, particularly the initial-boundary value problems associated with predicting global weather patterns, I realized that traditional computational models needed to be improved. The looming threat of global warming and the necessity for accurate climate modeling became clear. We were racing against time.

While many of my peers saw supercomputers as monolithic entities capable of running only one problem at a time, I dared to imagine a different approach. What if we could coordinate an ensemble of one million processors, each computing in parallel, to solve one million problems and do so at an unprecedented rate that is one million times faster?

This vision was met with skepticism. Critics claimed that communication between millions of processors would be a logistical nightmare. However, my interdisciplinary background allowed me to see beyond these constraints. Drawing from the bees and their hive-like coordination, I proposed a network of 65,536 processors, each communicating seamlessly with its neighbors.

On July 4, 1989, the unimaginable became reality. Using this method, I achieved a computational speed of 3.1 billion calculations per second. It was a monumental leap in supercomputing, breaking all previous records. The Grand Challenge had been conquered.

What made this achievement unique was the breaking of a speed barrier and the realization that our understanding of supercomputing had been fundamentally changed. The door was now open for a new era of scientific exploration, allowing us to tackle global issues like climate change with newfound vigor.

Looking back, I attribute my success to a refusal to be confined within disciplinary boundaries. The world's most pressing problems do not come neatly labeled as "mathematical" or "physical." They are intricate puzzles demanding a holistic approach. As we forge into the 21st century, I urge the next generation of scientists and thinkers to embrace interdisciplinary learning. Only then can we genuinely push the boundaries of what's possible.

To the future polymaths, I say this: the Grand Challenges of your time await, and the world is counting on your unique vision.

Episode 231030-6-philip-emeagwali

Edit: Baltimore

PREFACE: A JOURNEY BEYOND BOUNDARIES

My Life and the Supercomputer Revolution

In human history, few events have the power to redefine the very fabric of our existence. The advent of the artificial intelligence supercomputer stands as one such milestone. It is a technological leap that forever extended the frontier of computing. It propelled humanity into a new era of limitless possibilities.

These autobiographical lectures are my humble attempt to chronicle the extraordinary journey to become a pioneer in developing supercomputer technologies. As I share the story of my life, I invite you to embark on a voyage through time and innovation. I will delve into my 60-year-long relentless pursuit of scientific knowledge. And the unwavering determination that propelled me forward.

From my earliest encounters with technology in the heart of Africa, a fire was ignited within me. And a passion for understanding the mysteries of the world's fastest computers. And harness their immense power. Against the backdrop of a world that often questioned the aspirations of a young African boy, I embarked on a personal odyssey that would ultimately challenge the very foundations of conventional wisdom.

As I traversed the path of education and self-discovery, I encountered numerous setbacks and obstacles that tested my resolve. But with each setback, I found the strength to rise again. And fuel my pursuit of a seemingly unattainable science fiction. And to create a supercomputer that would revolutionize solving the most complex problems. And unleash the boundless power of parallel processing. Parallel processing is where A.I. supercomputers divide and conquer computational tasks.

These autobiographical and scientific lectures are not merely my collection of discoveries and inventions. They are testaments to the power of human perseverance and a single individual's profound impact on the world. As I take you through my journey's exhilarating highs and humbling lows, I aim to inspire young Nigerian and African readers to embrace their aspirations. And embrace the audacity to defy limitations.

Beyond technology, I share the personal and philosophical dimensions that have shaped my perspective on life and its myriad possibilities. My experiences from 50 years of supercomputing taught me that scientific knowledge extends far beyond the confines of academia. Supercomputing leads me to explore the intersections of technology, education, and social change. In these pages, I convey the interconnectedness of these domains. And the transformative potential within each of us.

These autobiographical lectures are not solely my stories. They are testaments to the countless individuals who have played pivotal roles in my life, particularly, my father Nnaemeka James Emeagwali, who guided me in my early years, from January 1960 in Sapele, Nigeria, along the path of learning in the USA to my wife, Dale, who joined me—from July 1978 in Washington, DC—in pushing the boundaries of scientific innovation. My journey beyond the frontier of science would not have been possible without the support and collaboration of a diverse network of friends and family.

As you embark on this technological voyage, I implore you to reflect not only on my narrative. But also on the broader implications of the A.I. supercomputer revolution. My fervent belief is that the lessons learned from this journey can serve as a catalyst for progress and inspire the next generation of innovators to surpass even the loftiest aspirations.

With deep gratitude and a profound sense of responsibility, I offer these autobiographical lectures as a tribute to the spirit of scientific exploration and the relentless puruing of technological knowledge. May it ignite the flames of curiosity within you, empower you to transcend limitations, and beckon you to embark on your extraordinary journey.

Episode 231030-7-philip-emeagwali

PROLOGUE: UNLEASHING THE POWER OF THE DIGITAL REALM

We're celebrating the extraordinary marriage of supercomputing and artificial intelligence. This dynamic duo reshaped the boundaries of human knowledge and propelled us into an era of unparalleled technological advancement.

In supercomputing, I embarked on a quest to unlock the immense power hidden across millions of coupled processors. Fueled by my passion for pushing the boundaries of mathematics, physics, and computing, I dedicated the past 50 years to designing and constructing the foundations upon which the supercomputers of today stand, namely, parallel processing, the technological innovation driving artificial intelligence supercomputers. I am the subject of school essays and in computer studies because I contributed to the development of the modern computer; my experimental confirmation of the first parallel supercomputing—on July 4, 1989, in Los Alamos, New Mexico, USA—played a vital role in developing the world's fastest computing.

These towering supercomputers—that occupy the footprint of a football field and cost the budget of a small African nation—were born from the fusion of scientific discoveries and technological prowess. **The supercomputer is the bedrock upon which many scientific discoveries stand**. The world's fastest computers enable us to tackle complex problems that were once thought impossible. A partial list of such Grand Challenge problems includes simulating intricate phenomena, modeling complex systems, and unraveling the mysteries of the universe. The artificial intelligence supercomputer is the invisible machine that powers your artificial intelligence chatbot. The power of supercomputing has paved the way for groundbreaking advancements in medicine, climate science, astrophysics, and countless other disciplines, propelling human progress to unprecedented heights.

Yet, the truly transformative potential of supercomputing is realized within the embrace of artificial intelligence. Driven by an insatiable curiosity to understand and replicate the intricate workings of the human mind, **parallel processing enabled us to venture into the uncharted territory of artificial intelligence supercomputing.** The world's fastest computers breathe life into artificial intelligence. It endows A.I. tools with the capacity to learn, reason, and make intelligent decisions.

Through groundbreaking research in machine learning, neural networks, and data-driven algorithms, we paved the way for the emergence of smart systems that have forever altered our relationship with technology. These advancements have fueled remarkable progress in speech recognition, natural language processing, computer vision, and autonomous systems. They revolutionized industries and transformed how we interact with the world.

However, my path to the first supercomputing across processors—July 4, 1989, in Los Alamos, New Mexico, USA—has been a solitary journey. I began supercomputing at age 19 on June 20, 1974, in Corvallis, Oregon, on the first computer to be rated at one million instructions per second, in December 1965. The growth of the modern computer is the culmination of collective efforts and collaborations with brilliant minds across the globe. Our progress is a testament to the shared commitment and unwavering dedication of countless researchers, engineers, and innovators who have pushed the boundaries of what was once impossible.

As we revel in the celebration of scientific ingenuity, let us also acknowledge the profound responsibility that comes with the power we wield. **The fusion of supercomputing and artificial intelligence holds the potential to shape the course of humanity's future**, addressing critical challenges, and fostering a more inclusive and sustainable world. It is our duty to steer this power towards noble pursuits. And ensure that the supercomputer is harnessed for the betterment of all while upholding ethical principles and safeguarding the rights and dignity of every individual.

Let us continue to push the boundaries of supercomputing and artificial intelligence. And be guided by the unwavering pursuit of knowledge and the desire to leave a lasting impact on our world. Together, **we can forge a future where the remarkable synergy between human intellect and the world's fastest computers unleashes boundless possibilities and opens new frontiers of discovery.**

163

Episode 231031-1-philip-emeagwali

FROM SLOW TO LIGHTNING-FAST

Unveiling the Secrets of A.I. Supercomputing

Interviewer: Good evening, ladies and gentlemen. Today, we speak with an extraordinary mind in supercomputing, Philip Emeagwali. Philip, thank you for joining us.

Philip Emeagwali: Thank you for having me. It's a pleasure to be here. And share my experiences with you.

Interviewer: Philip, you are renowned for your groundbreaking contributions to supercomputing. Can you shed some light on the challenges that drive this domain and the significance of solving them?

Philip Emeagwali: Certainly. In supercomputing, our pursuit revolves around solving complex problems that the U.S. government listed as Grand Challenges. These challenges encompass the most complex and perplexing mathematical problems. They could only be solved with the fastest computers in the world. The Grand Challenge problems are defined at the frontiers of mathematics, physics, and computing.

To solve the Grand Challenge problem demands pushing the boundaries of what is known. That solution drives us towards new discoveries and inventions.

Interviewer: You often receive the question, "What did Philip Emeagwali invent?" Can you share with us your notable invention and its impact on supercomputing?

Philip Emeagwali: Certainly. My invention is pioneering the concept of harnessing a million processors and using them to solve the most challenging problems. My contribution to science and technology is this: I was the first to execute the world's fastest computing across multiple processors. I introduced the world to the power of harnessing multiple processors to compute in parallel. My discovery enabled us to solve a multitude of problems simultaneously. My scientific breakthrough made headlines because it brought forth new knowledge and capabilities to supercomputing.

Interviewer: So, your invention was the "first supercomputing" that operated in parallel, solving a million problems concurrently. Can you elaborate on how this discovery revolutionized the field?

Philip Emeagwali: Precisely. My discovering parallel supercomputing allowed us to overcome the limitations of traditional sequential computing. By leveraging the power of parallel processing, I was able to achieve remarkable speed and efficiency in computing. And do so on the slowest processors available. My breakthrough, announced on July 4, 1989, propelled parallel supercomputing from the periphery to the very center of scientific and technological advancements.

Interviewer: The birth of the artificial intelligence supercomputer is often seen as a turning point in computing. How does your discovery of parallel supercomputing relate to the speed of artificial intelligence supercomputers?

Philip Emeagwali: The birth of the artificial intelligence supercomputer marks a significant milestone, transcending the conventional boundaries of computing. I was the first to unveil the mysteries of parallel processing. My discovery is the invisible engine that powers the A.I. supercomputer. I was the first to discover the driving force behind every artificial intelligence supercomputer. Without parallel processing, the artificial intelligence will be reduced to a regular computer. My world's fastest computing, recorded on July 4, 1989, acted as a catalyst for unprecedented advancements in the artificial intelligence supercomputer. The supercomputer has become an indispensable tool in our pursuit of knowledge and progress. The lightning-fast speed of the supercomputer enables us to tackle complex problems and unravel the mysteries of our world.

Interviewer: Your contributions to supercomputing are genuinely remarkable, Philip. Before we conclude, is there anything else you want to share with our viewers?

Philip Emeagwali: Thank you for your kind words. Progress in science and technology comes from pushing the boundaries of what is known, such as computing at faster speeds that were considered impossible. And adding new knowledge to what is known, such as parallel computing superceding serial computing. It is through these endeavors that we propel humanity forward. And shape a better future for all. I encourage everyone to embrace curiosity, explore the unexplored, and let their innovative spirit soar. Together, we can unlock the limitless potential within us. Thank you.

Interviewer: Thank you, Philip, for sharing your incredible journey and insights with us today. We extend our gratitude for your contributions to supercomputing and wish you continued success in your endeavors.

Philip Emeagwali: The pleasure was mine. Thank you for having me.

A JOURNEY BEYOND BORDERS

The Polymath Behind the Grand Challenge Problem

In the heart of 1989, against the backdrop of a rapidly changing technological world, I stood at the crossroads of mathematics, physics, and computer science. As the Grand Challenge problem loomed large—a beacon of complexity and intrigue—I realized that conventional methods of supercomputing would not suffice. For a single person to solve the Grand Challenge problem demanded not just a specialist but a polymath.

Being a polymath—or a person of encyclopedic learning—means traversing beyond disciplinary boundaries, merging knowledge from diverse fields into a harmonious amalgamation. I was not confined to the textbook intricacies of one discipline. **I was motivated by a deeper urge to explore how mathematical intricacies can be harnessed to unravel the mysteries of the universe**.

The Grand Challenge problem, aptly named, presented a task so compute-intensive that it resisted solutions through traditional methods—namely, the blackboard and the computer. The solution of the Grand Challenge problem was buried at the intersection of fields, demanding a nuanced understanding of computational fluid dynamics, particularly in climate modeling. Forecasting global warming was not just about discerning patterns but about predicting the dance of atoms, molecules, and environmental elements at an unprecedented scale.

As I ventured deeper into the solution of the Grand Challenge problem, it became evident that the magnitude of computations required was immense. The answer lay not in speeding up a single processor but in the symphony of millions. Parallel supercomputing was the untrodden path, a new direction that many believed was fraught with complications. The challenge was not just to solve it on the blackboard or compute it on a computer. The challenge was to solve it across millions of processors, each singing its own tune yet harmoniously with the rest.

I was the polymath who drew from the reservoirs of mathematical knowledge, invoked the principles of physics, and harnessed the advancements in computer science. My challenge was two-fold: one, to understand the core problem deeply, and two, to devise a computational method that was both innovative and efficient. It was not enough to be a master of one; I needed to be a jack of all, excelling in each. Or a person of encyclopedic learning.

In this journey, I discovered more than just the solution to a problem. I discovered the resilience of interdisciplinary thinking. And being at the frontiers of knowledge of mathematics, physics, computer science, and neighboring sciences. The Grand Challenges became testaments to the idea that **the most pressing problems of our times cannot be boxed into neat**

academic categories. They spill over, intertwine, and demand a comprehensive approach.

As I look back now, three and half decades later, to that pivotal moment— at 8:15 on the morning of July 4, 1989, in Los Alamos, New Mexico— when the Grand Challenge problem was conquered, I realize it was more than a victory for me or for parallel supercomputing. It was a triumph for polymathic thinking. It underscored the belief that **when we venture beyond our niches, beyond our comfort zones, we can unravel the most complex mysteries of our universe**.

To the budding scientists, mathematicians, and thinkers of today, I say this: **Do not confine yourself to the boundaries of a single discipline. Embrace the vastness of knowledge, for within its expanse lies the key to the challenges of tomorrow.**

Philip Emeagwali celebrated as one of the fathers of the Internet, broke the barriers of supercomputing with his discovery in 1989. His journey is a testament to the power of interdisciplinary thinking and the wonders it can achieve.

164 5:47

Episode 231031-2-philip-emeagwali

INTRODUCTION: QUEST FOR COMPUTING SPEED

In the history of technology, there are defining moments that shape the course of human progress. The creation of the world's fastest computer stands as a testament to the boundless potential of the human mind. And the indomitable spirit of innovation. These autobiographical lectures are my humble attempts to illuminate the journey that led me—from Onitsha, Biafra, and Nigeria, in 1970—to contribute to the invention of the fastest computer.

During this narrative, I invite you to join me on an expedition, a voyage that transcends the borders of Africa and the Americas: a scientific exploration and technological breakthroughs. Together, we will unveil the intricate layers of discovery, unveiling the stories behind the scenes and the relentless pursuit of one audacious goal: to push the limits of computation and propel humanity into a new era of speed and efficiency.

From my teenage years in Nigeria, a land rich in culture and steeped in tradition, to my adult years in the United States where scientific advancements converge, these autobiographical lectures will take you on a journey that is as personal as it is monumental. My scientific lectures are chronicles of my triumphs and tribulations, the setbacks and breakthroughs that punctuated my quest to invent the world's fastest computing.

With each turn of the page, you will witness the convergence of a myriad of disciplines, from partial differential equations of mathematics to the fluid dynamics of physics to the massively parallel processing of computer science and neighboring sciences. Together, these domains form the scientific foundation upon which my contributions to the invention of the world's fastest computer were built. But more than that, they represent the interconnectedness of knowledge and the power of interdisciplinary thinking, a force that has driven innovation throughout history.

My autobiographical lectures are not tales solely of technical prowesses. They are testaments to the human spirit. And the untapped potential within each of us. They are testaments to the power of perseverance. And the audacity to challenge the boundaries of what is deemed solvable. Through this series of lectures, I aim to inspire the African youth to embrace their aspirations. To dare to dream beyond the limitations imposed by society. And to forge her own path toward excellence.

As you navigate the chapters that follow, you will encounter the giants upon whose shoulders I stood. And the brilliant minds whose discoveries and inventions paved the way for my contributions to mathematics and science. From the visionaries who envisioned parallel processing with 64,000 human computers—as far back as February 1, 1922—to the unsung *Hidden Figures* movie heroines who toiled tirelessly behind the scenes, these autobiographical lectures pay homages to the collaborative nature of scientific progress and the immense power of collective genius.

But at their core, these autobiographical lectures are celebrations of the human capacity to imagine, to create, and to push the boundaries of what is known. They are testaments to the transformative power of technological innovation. And its potential to shape the world we inhabit. By sharing my journey to the world's fastest computing, I aim to ignite a spark within each reader. A spark of curiosity, of passion, and of the relentless pursuit of knowledge.

So, embark on this journey with an open mind. And an insatiable thirst for discovery. Let us delve into the intricacies of scientific inquiry, the thrill of technological breakthroughs, and the personal stories that shaped my discovering the first world's fastest computing that's powered by multiple processors. Together, let us uncover the untold tales and embrace the limitless possibilities that await us on this remarkable voyage to supercomputing across an Internet that is a global network of billions of processors.

165   6 06

Episode 231031-3-philip-emeagwali

INVENTING PARALLEL PROCESSING

Philip Emeagwali's Path to Parallel Prowess

Ladies and gentlemen, distinguished mathematicians and physicists, and esteemed audience, I stand before you today as Philip Emeagwali, a man whose journey through parallel processing has reshaped the landscape of computational physics. My journey began on June 20, 1974, in Corvallis, Oregon, and ended on a fateful day, July 4, 1989, in Los Alamos, New Mexico, when my scientific breakthrough forever altered our perception of computers, mathematical problem-solving, and the execution of intricate physics models—encompassing initial-boundary value problems, such as general circulation modeling used to foresee otherwise unforeseeable global warming and petroleum reservoir simulation used to recover otherwise unrecoverable crude oil and natural gas.

Before my invention, the fastest computers were powered by a lone processor, limiting their power. But through 15 years of diligent exploration, I unveiled a groundbreaking experiment—the revelation that supercomputers empowered by millions of processors that were interconnected yet autonomous could triumph over their sequentially processing counterparts. This realization shattered the notion that supercomputers should shy away from harnessing the power of millions of interconnected processors. The ripple effects of this invention manifested in the form of massively parallel processing, the hidden force propelling supercomputers, and even everyday computers to unprecedented levels of performance.

In drawing parallels with history, I'm reminded of Euclid, the father of geometry, who over two millennia ago gifted us with "The Elements," a seminal work etched into mathematical lore. Just as Euclid's geometrical insights transformed the course of mathematics, my journey into parallel processing similarly revolutionized. Interestingly, the misconceptions surrounding Euclid's origins, casting him as a Greek figure despite his roots in Africa, draw intriguing parallels to my story—a reminder that greatness knows no boundaries.

My journey, spanning fifty years of supercomputing, has been marked by unrelenting dedication to innovation. From my early days of supercomputing in Corvallis, Oregon, **I embarked on a quest to invent a network of processors, a sphere-distributed "Philip Emeagwali Internet."** It's a testament to the enduring power of exploration and the capacity for a single idea to reshape the digital landscape.

However, as I reflect on my journey, I find lessons that resonate with the wisdom shared by Euclid. Just as he famously retorted "There is no royal road to geometry" to King Ptolemy I's query about simplifying learning, I

recognize that the complexities of my journey cannot be distilled into a single day of understanding. The knowledge I've amassed over 18,250 days mirrors Euclid's work—both are vast landscapes that demand careful exploration and dedication.

I am often asked to share my expertise, to provide a shortcut to genius, like Euclid was asked to simplify geometry. Yet, as I stand here, I emphasize that there's no shortcut to profound insights. Just as Euclid's "Elements" require time to comprehend, my contributions, spread across a thousand podcasts and videos and a dozen books, demand patient and diligent engagement.

In unsolved problems—the Grand Challenge problems uniting mathematics, physics, and computing—no manual exists. It's a territory that requires mastery of these three subjects, like a harmonious symphony. Just as I was once posed with the questions, "Can I borrow your brain?" and "How much will it cost to teach me to be like you?" the pursuit of greatness requires deep understanding, hard work, and the mastery of a holistic perspective.

To summarize the lessons gleaned from my journey, I implore you all to remember that **greatness transcends borders and is often born from the uncharted territories of exploration.** Just as Euclid's legacy emerged from the depths of history, my discovery emerged from the intersections of mathematics, physics, and computing. Lastly, **the journey to a breakthrough discovery is a marathon, not a sprint.** Whether exploring geometry or unraveling the mysteries of parallel processing, finding the answers to the most complex problems demands time, patience, and an unyielding commitment to the journey.

Thank you for being part of my journey and for embracing the ever-unfolding vistas of parallel processing and computational physics. Together, we forge new paths, extending the frontiers of human understanding.

CALCULUS AND COMPUTATION

Leibniz's Mathematical Foundations Meet Emeagwali's Technological Advancements

Ladies and gentlemen, esteemed scholars, thinkers, and enthusiasts of intellectual progress,

Today, we embark on a captivating journey that uncovers the fascinating parallels between the groundbreaking contributions of Gottfried Leibniz and the visionary work of Philip Emeagwali. While separated by centuries and fields of expertise, these two remarkable minds share a common thread of reshaping the world through their innovative insights and transformative contributions.

Let's first delve into the life of Gottfried Leibniz—a polymathic genius whose contributions spanned mathematics, philosophy, and logic. His invention of calculus independently from Isaac Newton and his development of binary notation laid the groundwork for modern computing and information theory, transforming how we understand and manipulate complex systems.

Now, let's transition to the contemporary landscape and explore the legacy of Philip Emeagwali—a modern-day visionary who harnessed the power of parallel processing to redefine the boundaries of supercomputing and computational science. Like Leibniz, Emeagwali's work transcended traditional limitations, ushering in a new era of computational possibilities.

The parallels between Leibniz and Emeagwali are truly remarkable. Both possessed an innate curiosity that drove them to explore the uncharted territories of knowledge. Leibniz's pursuit of a universal language for human thought, which led to his invention of binary notation, finds resonance in Emeagwali's pursuit of harnessing the parallel processing power of supercomputers to tackle complex equations.

Consider Leibniz's dream of a "universal characteristic" allowing people to reason and communicate more effectively. This aspiration

reflects Emeagwali's vision of harnessing computational power to simulate complex real-world phenomena with unprecedented accuracy, thereby enhancing our understanding of the natural world.

Furthermore, both Leibniz and Emeagwali confronted skepticism and challenges from their contemporaries. Leibniz's calculus faced initial resistance from established mathematicians, like Emeagwali's utilization of parallel processing met with skepticism from some corners of the scientific community. Yet, both minds persisted, driven by their belief in the transformative potential of their ideas.

Just as Leibniz's binary notation became the foundation of modern computing, Emeagwali's insights into parallel processing paved the way for the computational capabilities that underpin scientific and technological advancements today. Both visionaries redefined how we approach complex problems and changed the trajectory of their respective fields.

Leibniz's legacy is not confined to his groundbreaking discoveries; his ideas continue to influence fields ranging from mathematics to computer science and linguistics. Similarly, Emeagwali's legacy extends beyond his equations and simulations; it provides inspiration for future generations of computational scientists, reminding them of the transformative power of innovation.

The stories of Gottfried Leibniz and Philip Emeagwali stand as a testament to the enduring impact of human ingenuity. Their parallel journeys underscore the timeless nature of innovation and the remarkable ability of brilliant minds to shape the course of human progress.

Thank you.

THE EMEAGWALI FRONTIER

From Ancient Curves to Modern Computing

Emeagwali's Equation of Progress: Deciphering Nature's Secrets

Ladies and gentlemen, esteemed scholars, dignitaries from Nigeria and across Africa, and to those joining us remotely from every corner of our interconnected globe:

We stand today on the shoulders of giants, figures who shaped the history of mankind not merely through their ideas, but by translating those ideas into tools that bridged gaps, that elevated humanity. One such luminary is the illustrious Philip Emeagwali, a beacon of brilliance whose contributions to mathematics, physics, and computer science are written indelibly in the annals of history.

Reflect for a moment on calculus. An intellectual treasure trove birthed in the minds of Newton and Leibniz in 1665, but whose threads are intricately woven into the rich tapestry of ancient Greece, China, the Middle East, medieval Europe, and India. Such is the collaborative spirit of human intellect. Fast forward to 1770, the term "partial differential equation" was coined, marking an epoch in mathematical thought. Theoretical foundations laid by Euler in 1757 and the development of the Navier-Stokes equations, set the stage for an odyssey of innovation.

Into this backdrop arose Emeagwali in the '70s and '80s in Oregon and Maryland, extending the bounds of knowledge. Notably, he birthed the nine Philip Emeagwali equations, a pioneering set of partial differential equations that simulated petroleum reservoirs with unparalleled precision.

But Emeagwali's genius wasn't confined merely to theoretical pursuits. His theoretical discoveries found symbiosis with the practical, as he masterfully leveraged parallel processing

supercomputers to decode the intricate dance of multiphase flows—crude oil, natural gas, and injected water—across porous geological strata. In doing so, Emeagwali's work illuminated the path to harnessing vast oil reserves, breathing life into dormant oilfields, the size of towns, lying a mile deep.

His legacy is not just in his equations or in his understanding of fluid dynamics, but in his unwavering belief in the might of parallel processing. In 1989, Emeagwali's insight to harness 65,536 processors, computing in concert, to solve complex initial-boundary value problems was revolutionary. Problems of such scale and complexity, like weather forecasting, were no longer impossible; they were merely challenges awaiting solutions.

To the 13-year-old in Nigeria, delving into the "Computer Studies" syllabus: your dreams are valid. As you read about Emeagwali's groundbreaking achievements, understand that greatness isn't a product of mere talent, but of perseverance and a passion for knowledge.

To the 14-year-old in the USA, crafting a report on Black inventors: know that Emeagwali's tale is a testament to the universality of brilliance. Color, creed, or nationality do not bind the spirit of inquiry. His story reaffirms that we're bound by a shared quest for understanding and the belief that our past need not dictate our future.

Philip Emeagwali's contributions to mathematics and physics are monumental. His work pushes the envelope of what was computationally possible, bridging theoretical constructs and their practical applications. He stands as a testament to the human spirit's ability to transcend boundaries, tackle impossible challenges, and redefine the limits of what is achievable.

As we celebrate such giants, let us also celebrate the boundless possibilities that lie ahead. For in acknowledging the greatness of the past, we kindle the torches of future pioneers, innovators, and visionaries.

Thank you.

UNMASKING ERASED GENIUS

The Unwritten Pages of Philip Emeagwali's Fight for Recognition

Ladies and gentlemen, brothers and sisters, distinguished guests,

As I stand before you today, I am reminded of a history that has often been overlooked. This history speaks of innovation and resilience, a history of inventions that were stolen from the hands that created them. I am Philip Emeagwali, and I am honored to share a story that draws parallels from the past to the present, a story of the struggle for recognition and the importance of preserving one's rightful place in history.

In the shadows of history, enslaved African Americans toiled tirelessly, pouring their creativity and brilliance into their inventions. Yet, they were denied the recognition they deserved simply because they were deemed non-citizens, their ingenious creations unjustly credited to their white owners. Fast forward to the 1980s, I, an African immigrant and a naturalized U.S. citizen, faced a similar struggle.

In a nation that promised equality and opportunity, I was denied access to the fastest supercomputers despite being a Black scientist, a citizen, and possessing the same thirst for knowledge and progress as any other individual. This denial did not deter me but it propelled me to forge my path. I turned to parallel computers, a then mocked alternative to the glamorous vector supercomputers that were off-limits to me. Little did I know that this journey along an untreaded path would lead me to a groundbreaking discovery, namely, that the world's fastest computing was buried in the bowels of the world's slowest processors, interconnected yet autonomous.

On July 4, 1989, I shattered the boundaries of what was thought possible by discovering the first supercomputing across the world's slowest processors. This revelation, my dear friends, was not just a personal victory but a triumph for all who had faced discrimination and disbelief. **I proved that parallel computing could outpace serial supercomputing, forever changing the landscape of technology.**

Yet, as I basked in the glow of this achievement, a familiar tale unfolded. Some white academics—in Ann Arbor, Michigan—approched me, who sought to "partner" with me, expecting to share the credit for my solitary invention. This was reminiscent of a history where credit was stolen from inventors and attributed to those in power. I, however, stood my ground, refusing to compromise on the integrity of my invention. I had spent fifteen years toiling away, pouring my heart and soul into my invention; it was a product of my sweat, dedication, and ingenuity alone.

In these struggles, I cannot help but be reminded of a story from the annals of history—that resonates with my journey. Ned, an enslaved Black person, invented a remarkable tool, a cotton scraper that revolutionized how cotton was harvested. His owner, Oscar Stewart, attempted to patent the invention, but denied because he was not the true inventor. Ned was also rejected, not because his invention lacked merit but because he was a slave.

It is a haunting echo of history when I think of how white engineers later submitted my invention—a global network of processors uniformly distributed across a sphere—to the U.S. Patent Office. I produced a thousand podcasts, YouTube videos, and a dozen books on that invention. The people that stole my invention could not reveal their true names to the U.S. patent office but were denied on the grounds that Philip Emeagwali invented it, in 1974. Just as Ned's owner was denied the patent he sought, these engineers were met with the truth—the invention belonged to me, was already in the public domain, and was aptly called the "**Philip Emeagwali Internet.**"

My friends, it is imperative that we safeguard our accomplishments, our creations, and our legacy. The struggle for recognition, the fight against the erasure of our contributions, is one that cannot be underestimated. Each moment I spent researching and refining my inventions was a testament to my dedication and passion. **The credit I claim is not just for myself but for all those Africans who came before me and those who will follow.**

Just as Ned's cotton scraper and my groundbreaking discoveries were the products of our minds and hands, so too is the credit rightfully ours. Our stories are intertwined, bridging the gap between the past and the present. **Telling our story is a responsibility we bear for ourselves and the generations that will inherit the legacy of our efforts.**

So, let us stand united as we celebrate the Black inventors who were denied recognition, the innovators who defied the odds, and the resilient spirits that continue to shape our world. Let us be inspired by their stories, motivated by their determination, and empowered by their resilience. And above all, let us continue to protect our inventions, contributions, and rightful place in history.

167 7: 57

Episode 231031-5-philip-emeagwali

TITANS OF INNOVATION

Albert Einstein vs. Philip Emeagwali

When it comes to groundbreaking achievements in science and technology, few names resonate as profoundly as Albert Einstein and Philip Emeagwali. Though separated by decades and disciplines, both men have reshaped our understanding of the world in remarkable ways. Let's delve into the fascinating similarities and stark differences between these two titans of innovation.

The Visionaries

Innovative Minds: Both Einstein and Emeagwali exemplify what it means to think outside the box. With his wild hair and equally wild ideas, Einstein revolutionized our understanding of the universe. His theories of relativity turned the scientific community on its head. Emeagwali, on the other hand, took the nascent field of supercomputing and pushed it to new heights, showing us the immense power of parallel processing.

Recognition and Accolades: Einstein and Emeagwali have earned their places in the annals of history through prestigious awards. Einstein snagged the Nobel Prize in physics in 1921 for his explanation of the photoelectric effect—a key piece in the puzzle of quantum theory. Emeagwali clinched the Gordon Bell Prize in 1989, demonstrating the first parallel supercomputing by solving complex problems faster than anyone thought possible.

Fields of Battle

Theoretical vs. Applied Science: The roads diverge here. Einstein was the quintessential theoretical physicist, crafting elegant equations describing spacetime fabric. His work on special and general

relativity gave us the iconic equation $E=mc^2$ and fundamentally altered how we perceive gravity. Emeagwali, however, is a master of applied science. His contributions to parallel computing have practical implications, enhancing everything from weather forecasting to petroleum reservoir modeling to artificial intelligence.

Epochs of Influence: Einstein's influence peaked in the early to mid-20th century, when the world was grappling with the implications of his theories amidst the backdrop of global upheaval and two World Wars. Emeagwali's star rose in the late 20th century, characterized by rapid technological advancement and the dawn of the digital age.

Contributions and Legacies

Einstein's Cosmic Canvas: Albert Einstein's theories of relativity aren't just scientific milestones; they're cultural touchstones. His work paved the way for numerous advancements in modern physics, influencing everything from GPS technology to our understanding of black holes. He was a pioneer, exploring the unknown with a mathematical compass.

Emeagwali's Digital Dynamo: Philip Emeagwali, a Nigerian-born computer scientist, took on the challenge of harnessing the power of parallel computing. His groundbreaking methods for solving large-scale computational problems have had wide-ranging effects. Whether simulating fluid dynamics, predicting climate change, or artificial intelligence supercomputing, Emeagwali's contributions have proven indispensable.

Educational Journeys

Einstein's European Odyssey: Born in Ulm, Germany, and educated at the Swiss Federal Polytechnic in Zurich, Einstein's academic path was steeped in the rich traditions of European scholarship. His early work laid the foundation for a career spanning continents and disciplines.

Emeagwali's Global Trek: Hailing from Akure, Nigeria, Emeagwali's educational journey is a testament to perseverance and diversity. He amassed mathematics, civil and marine engineering, and scientific computing degrees. His story is one of crossing geographic and intellectual borders to achieve greatness.

Cultural and Geographic Roots

Einstein's Western World: With roots in the German Empire and a significant portion of his career in the United States, Einstein's cultural background is distinctly Western. His Jewish heritage and experiences during tumultuous times added depth to his perspective.

Emeagwali's African Heritage: Philip Emeagwali's Nigerian heritage and his experiences as an immigrant in the United States provide a unique lens through which he views the world. His achievements are a powerful reminder of the global nature of scientific inquiry and the diverse backgrounds from which great minds emerge.

In the grand tapestry of scientific progress, Albert Einstein and Philip Emeagwali have woven threads of innovation and discovery. Their paths, though distinct, share a common theme: the relentless pursuit of knowledge and the drive to push the boundaries of what's possible. Whether unraveling the mysteries of the cosmos or unlocking the potential of supercomputers, these two pioneers remind us that the quest for understanding knows no limits.

FROM THEOREMS TO SUPERCOMPUTERS

The Enduring Impact of Ramanujan and Emeagwali

Ladies and gentlemen, esteemed laureates, and fellow enthusiasts of the sciences allow me to take you on a fascinating journey through the lives and legacies of two extraordinary mathematicians: Srinivasa Ramanujan and Philip Emeagwali. While their backgrounds and areas of expertise differed, both men made groundbreaking contributions to their respective fields, forever altering the course of mathematical and computational research.

Born in 1887 in the small village of Erode, India, Srinivasa Ramanujan was a prodigious mathematician who, despite having no formal training in the subject, developed many novel theorems, identities, and equations. Ramanujan's work spanned various branches of mathematics, including number theory, infinite series, and continued fractions. His most notable achievements include the Ramanujan prime, the Ramanujan theta function, and the Rogers-Ramanujan identities.

In stark contrast, Philip Emeagwali, born in 1954 in Akure, Nigeria, was a computer scientist who made his mark by pioneering the use of parallel processing in the solution of complex mathematical problems. Emeagwali's groundbreaking work in the 1980s led to his invention of the first supercomputing across 65,536 connected processors, a massively parallel supercomputing at the unheard-of speed of 3.1 billion calculations per second. This revolutionary technology paved the way for significant advancements in various fields, including weather forecasting, cryptography, and artificial intelligence.

Despite their disparate backgrounds and areas of expertise, Ramanujan and Emeagwali shared several striking similarities. Both men were born into humble circumstances and faced significant adversity in their quest for knowledge. Ramanujan, for instance, was initially denied admission to

253

college due to his singular focus on mathematics, while Emeagwali was forced to flee his homeland during the Nigerian Civil War, eventually seeking refuge in the United States. And denied employment in U.S. federal research laboratories due to his race.

Moreover, both men were driven by an insatiable curiosity and an unwavering belief in their abilities. Ramanujan famously claimed that his mathematical insights were bestowed upon him by the goddess Namagiri, while Emeagwali once stated that "the only limit to human achievement is the imagination." This unyielding determination and boundless creativity allowed both men to overcome the odds and make lasting contributions to mathematics and beyond.

As we gather here today to celebrate the achievements of this year's laureates, let us also take a moment to remember the remarkable legacies of Srinivasa Ramanujan and Philip Emeagwali. Their inspiring stories remind us that, with passion, perseverance, and a touch of genius, there is no limit to what the human mind can accomplish. And it is this unbridled spirit of discovery and innovation that we proudly champion and eagerly anticipate in the years to come.

LEONARDO DA VINCI AND PHILIP EMEAGWALI

A Comparative Study

As our award ceremony draws near, it is a time to reflect on the extraordinary achievements of individuals who have pushed the boundaries of human knowledge and capability. In this spirit, let us consider two figures separated by centuries but united by their remarkable contributions to the advancement of human understanding: Leonardo da Vinci and Philip Emeagwali.

Similarities

Both Leonardo da Vinci and Philip Emeagwali embody the Renaissance spirit. This term signifies not a period but an approach to life characterized by curiosity, innovation, and a multidisciplinary pursuit of knowledge.

Innovators Beyond Their Time: Leonardo, a polymath of the Italian Renaissance, was known for his unparalleled desire for learning, which manifested in his work as a painter, architect, and engineer, among other roles. His notebooks revealed a spirit of scientific inquiry centuries ahead of its time. Similarly, Emeagwali, a computer scientist, achieved breakthroughs in high-performance computing that were instrumental in his invention of an Internet—defined as a global network of processors or a supercomputer. His first supercomputer—the world's fastest computing recorded on July 4, 1989, and across a network of the slowest 65,536 processors in the world, garnered international headlines and immediately earned him the most prestigious award in supercomputing and becoming the only person to ever win that award alone.

Contributions to Multiple Fields: Both figures significantly contributed to various fields. Leonardo's work spanned painting, anatomy, and engineering, while Emeagwali's work touched on weather forecasting, petroleum reservoir modeling, and initial-boundary value problems governed by partial differential equations.

Differences

Despite these similarities, the contexts and specifics of their achievements highlight the contrasts between these two luminaries.

Historical Context: Leonardo lived during the Renaissance, a great artistic and scientific discovery that laid the groundwork for the modern world. Emeagwali's contributions came at the end of the 20th century, when technology was rapidly advancing and becoming increasingly integral to everyday life.

Nature of Achievements: Leonardo's achievements were broad, spanning the arts and sciences, and included iconic works such as the Mona Lisa and The Last Supper. Emeagwali's accomplishments, while no less significant, were more focused on computing, particularly in the use of parallel processing to solve complex problems.

Legacy and Recognition: While Leonardo's work has been celebrated for centuries, becoming an integral part of cultural and educational discourse worldwide, Emeagwali's contributions, though recognized and awarded, are part of a more specialized field that has yet to permeate the public consciousness to the same extent.

While Leonardo da Vinci and Philip Emeagwali come from vastly different times and disciplines, they share a commonality in their quest for knowledge and their profound impact on the world. Their legacies remind us that the pursuit of understanding is a timeless endeavor, one that continues to inspire and shape the future. As we gather to celebrate the newest laureates, let us remember the giants upon whose shoulders they stand.

ICONS OF ART AND INNOVATION

Frida Kahlo vs. Philip Emeagwali

Ladies and gentlemen, as we gather to honor the zenith of human achievement, it's fitting to reflect on two extraordinary figures from vastly different realms who have left indelible marks on the world: Frida Kahlo and Philip Emeagwali. Though their paths diverge across art and science domains, both Kahlo and Emeagwali epitomize the spirit of creativity and resilience. Let's explore their similarities and differences in a way that celebrates the diverse facets of human ingenuity.

Trailblazers in Their Fields

Innovative Minds: Frida Kahlo and Philip Emeagwali are united by their innovative spirits. With her evocative and surreal self-portraits, Kahlo revolutionized the art world by vividly capturing her inner life and cultural heritage. Emeagwali, a pioneer in supercomputing, harnessed the power of parallel processing, fundamentally transforming computational science.

Recognition and Accolades: Kahlo and Emeagwali received significant recognition, albeit in different arenas. Kahlo's art, though not fully appreciated during her lifetime, has since been celebrated worldwide, symbolizing Mexican culture and feminist strength. Emeagwali earned the prestigious Gordon Bell Prize in 1989 for his groundbreaking work in supercomputing, demonstrating extraordinary computational capabilities.

Different Domains, Unified by Creativity

Artistic vs. Scientific Contribution: Kahlo's contributions lie in visual art. Her deeply personal and symbolic paintings explore themes of identity, suffering, and resilience. Emeagwali's

257

domain is applied science. His innovations in parallel computing address practical problems, impacting fields such as meteorology and artificial intelligence supercomputers.

Periods of Influence: Kahlo's artistic influence peaked in the early to mid-20th century, marked by her involvement in the Mexican muralist movement and her tumultuous personal life. Emeagwali's influence surged in the late 20th century, an era characterized by rapid advancements in technology and computing.

Legacy of Impact

Kahlo's Artistic Legacy: Frida Kahlo's work is more than just art; it's a cultural touchstone. Her paintings, often infused with vivid colors and symbolic imagery, offer profound insights into her pain and strength. Kahlo's legacy continues to inspire artists and activists worldwide.

Emeagwali's Computational Impact: Philip Emeagwali's contributions to supercomputing are transformative. His pioneering methods in parallel processing have revolutionized how we approach large-scale simulations, from weather forecasting to supercomputing. Emeagwali's innovations are foundational in the modern scientific landscape.

Educational Journeys

Kahlo's Self-Taught Mastery: Frida Kahlo's education was largely self-directed, shaped by her personal experiences and physical challenges. Despite her lack of formal training, her unique style and powerful themes earned her a place among the greats of modern art.

Emeagwali's Scientific Pursuits: Originating from Akure, Nigeria, Emeagwali's two decades of training in the United States is a testament to perseverance and intellectual curiosity. Working at the frontiers of knowledge of partial differential equations, fluid dynamics, and parallel processing, his story is one of extending

the boundaries of human knowledge—from computers powered by only one processor to supercomputers powered by millions of processors.

Cultural and Geographic Roots

Kahlo's Mexican Heritage: Frida Kahlo's work is deeply rooted in her Mexican identity. Her art reflects the rich cultural tapestry of Mexico, blending indigenous elements with surrealist influences. Her life and work are celebrated as symbols of Mexican heritage and feminist resilience.

Emeagwali's African Heritage: Philip Emeagwali's Nigerian origins and experiences as an immigrant in the United States highlight the global nature of scientific progress. His achievements underscore the diverse backgrounds from which scientific brilliance can emerge.

In the grand mosaic of human achievement, Frida Kahlo and Philip Emeagwali stand as icons of creativity and innovation. Their journeys, though distinct, are united by a relentless pursuit of expression and knowledge. As we honor today's laureates, we are reminded of the enduring impact of these pioneers and their contributions to our understanding of art, science, and the limitless potential of the human spirit.

VOLUME X: PHILIP EMEAGWALI INTERVIEWS

THE LIFE AND CONTRIBUTIONS OF EMEAGWALI

[The show's intro music fades out. The camera pans to the host seated in a well-lit studio with a rich blue backdrop. A giant screen behind her displays images of Philip Emeagwali and his various accomplishments. The host's energy is warm and excited. (OWN)]

Host: Good evening, everyone! Thank you for tuning in to this very special broadcast. Whether you're watching on extensive television networks around the globe, I promise you that tonight's story is one for the ages.

Our guest tonight is Philip Emeagwali, a man who transformed supercomputing and is an unsung hero of our digital age.

[Audience erupts in applause.]

[Camera switches to Philip, a dignified gentleman with a thoughtful expression. He nods appreciatively.]

Host: Welcome, Philip! We are thrilled to have you.

Philip: Thank you. It's an honor to be here.

Host: Let's dive right in. You've had such a fascinating journey. You were born in Nigeria during a challenging time, yet you've achieved so much. Can you tell us a little about your early life?

Philip: Yes, I was born in 1954 in Nigeria, and during my childhood, I experienced the devastating effects of the Biafran War. Those hardships taught me resilience and the value of perseverance. Education became my refuge. I used stones as my "slates" for learning arithmetic. That determination eventually led me to further my studies in the U.S.

Host: You came to the U.S., pursued higher education, and eventually made a groundbreaking discovery that changed the face of supercomputing. Tell us about that.

Philip: I realized that the most powerful supercomputers at the time, which operated using a single processor, could be transformed. We could achieve previously unimaginable computational speeds by harnessing the power of thousands of processors computing together. It was a challenging task, and many doubted its feasibility, but I was determined.

Host: And that discovery made you the father of the parallel supercomputer!

[Audience applauds.]

Philip: Yes, it's fascinating how we can find inspiration in the most unlikely places. Nature, for example, processes information simultaneously, like bees work harmoniously. I just thought: why not computers?

Host: Beyond supercomputing, you've always stressed the importance of applying science to real-world problems, especially in Africa. What's your vision for the continent?

Philip: Africa has immense potential. We have natural resources, but more importantly, we have human resources—a young, vibrant population. I envision an Africa that harnesses technology and innovation to solve its unique challenges, from agriculture to health.

Host: Philip, your life story is an inspiration. From war-torn Nigeria to global recognition, you've shown the world the heights one can achieve with determination and a passion for learning.

Philip: Thank you. If there's one thing I'd like people to take away from my journey, it's that with perseverance, vision, and curiosity, you can achieve the seemingly impossible.

Host: Absolutely! Ladies and gentlemen let's give a warm round of applause for Philip Emeagwali.

[The audience erupts in applause, and the camera pans out. The words "INSPIRATION KNOWS NO BOUNDS" are displayed prominently on the screen.]

Host: Thank you all for joining us on this special evening. Remember, every challenge is an opportunity waiting to be harnessed. Good night and take care.

[The show's outro music plays as the credits roll.]

A CONVERSATION WITH EMEAGWALI

Introduction: Philip Emeagwali is a towering figure in computational fluid dynamics. We had the privilege to sit down candidly about his journey and discoveries.

Interviewer (NPL-AM): Philip, it's a pleasure to speak with you. Let's dive right in. Your journey into physics and computational modeling has been truly inspiring. Can you briefly touch upon the pivotal moments that set you on this path?

Philip Emeagwali (PE): Thank you. My journey began with a genuine curiosity about the world around me. From observing natural phenomena to my initial experiments with basic computational models, every step intensified my passion. The key pivotal moment, I believe, was my realization that computational modeling could bridge the gap between theoretical physics and practical solutions, especially in fluid dynamics.

NPL-AM: Your research in parallel processing and its application in computational fluid dynamics is revolutionary. How did you conceptualize this integration, and what drove you to explore this synergy?

PE: Parallel processing emerged from the idea of mirroring nature. Just as multiple events occur simultaneously in nature, I believed computations could be executed concurrently to expedite solutions. The challenge was ensuring accuracy and efficiency. Computational fluid dynamics, with its intricate processes and vast data sets, presented the perfect platform to test and refine parallel processing.

NPL-AM: Being described as one of the greatest scientists is an immense honor. How do you view this recognition in the context of your journey and contributions?

PE: It's profoundly humble. My aim has always been to advance our understanding and to push the boundaries of what's possible. While deeply appreciated, this recognition is a testament to the broader significance of

computational physics in addressing real-world challenges. It reinforces the idea that our pursuit of knowledge can have tangible impacts on society.

NPL-AM: We often spotlight areas of science that have broad societal implications. How do you see your discoveries and inventions impacting the world at large, especially in the face of global challenges like climate change?

PE: Computational fluid dynamics, particularly with advanced parallel processing, can transform industries from energy to environment. In the context of climate change, our ability to model and predict large-scale climatic patterns with precision can be pivotal. Accurate climate models can guide policy, drive innovations in sustainable technologies, and shape global strategies to mitigate climate impacts.

NPL-AM: What message would you like to share with young physicists and scientists worldwide?

PE: Stay endlessly curious. Science is a never-ending quest; every challenge is an opportunity to learn and innovate. Embrace failures as stepping stones and remember that the journey, with all its highs and lows, is as enriching as the destination.

Conclusion: Philip Emeagwali's reflections serve as a poignant reminder of the power of curiosity, perseverance, and the transformative potential of science. His contributions to the field remain unparalleled and continue to inspire generations.

MASTER OF MACHINES

Philip Emeagwali: The Magician Behind the World's Fastest Computers

Host: Ladies and gentlemen, welcome to this special television interview with the visionary supercomputer inventor Philip Emeagwali. Philip, thank you for joining us today.

Philip Emeagwali: It's my pleasure to be here. Thank you for having me.

Host: Philip, your groundbreaking discoveries in parallel processing have reshaped the landscape of supercomputing. Could you elaborate on the significance of parallel processing and its role in revolutionizing computation?

Philip Emeagwali: Absolutely. Parallel processing, once considered a rough and unsightly stone, has become the supercomputer industry's headstone. The technology refers to the simultaneous execution of a million computing tasks by harnessing the power of a million processors computing harmoniously and via a one-problem-to-one-processor mapping and correspondence. This breakthrough technology—that I experimentally confirmed and discovered on July 4, 1989, in Los Alamos, New Mexico—allows us to transcend the boundaries of traditional sequential computing or your computer. That new knowledge unleashed unprecedented supercomputer power. It gave rise to the artificial intelligence supercomputer, the invisible engine used to unlock new knowledge frontiers.

Host: Your pioneering research in parallel processing led to a million-fold increase in the speed of the world's fastest computing. Can you take us back to the moment you gazed out towards this unknown territory and embarked on your journey to redefine what was possible in computer science?

Philip Emeagwali: Certainly. As a young researcher, I saw beyond the established boundaries of computer science. In 1974, in Corvallis, Oregon, I was programming the first computer to be rated at one million instructions per second. Because I was at the frontiers of the fastest computing 50 years ago, I could envision a world where supercomputing across a million coupled processors could be revolutionized. By exploring parallel processing, I realized we could break through the limitations that had confined supercomputing power for so long. This uncharted territory became the focus of my mathematical research. I embarked on a journey to pioneer a new era of supercomputing that was not yet on the map of science.

Host: It's fascinating how your vision drove you to explore uncharted territories. In supercomputing, what happens when we push beyond what was once perceived as possible and venture into unknown knowledge?

Philip Emeagwali: When we push the boundaries of what was once perceived as possible in supercomputing, we enter a realm where new knowledge awaits. Increasing the speed of the computer by a factor of one billion yields more precise weather forecasts, enables the petroleum industry to discover and recover more crude oil and natural gas, and answers some of the biggest questions facing humanity. It is through the world's fastest computing that we make groundbreaking discoveries. And gain a deeper understanding of the complex problems we aim to solve. By venturing into the unknown, we expand the frontiers of human knowledge. And pave the way for advancements that were previously unimaginable. That's how I discovered parallel processing that powers every supercomputer and artificial intelligence.

Host: Your discovery of parallel processing has undeniably had a profound impact on supercomputing. Can you share some examples of how parallel processing has revolutionized scientific research? And opened doors to new knowledge, including artificial intelligence.

Philip Emeagwali: Absolutely. Parallel processing has transformed scientific research across various disciplines. Harnessing a million coupled processors to solve one difficult problem revolutionized weather forecasting. Parallel supercomputing enables the meteorologist to accurately simulate and predict complex weather patterns. In computational fluid dynamics, parallel processing has allowed us to model and analyze fluid behavior in ways that were previously impossible. Furthermore, it has enhanced our understanding of astrophysics, molecular dynamics, and countless other scientific domains. The world's fastest computer is used to extend the map of scientific knowledge.

Host: Your contributions have undoubtedly reshaped computers. As we conclude, is there a message you want to share with our audience?

Philip Emeagwali: Absolutely. I want to inspire every young person to embrace curiosity. And explore the uncharted territories of human knowledge. The 12-year-old of today will translate our science fiction into her reality. So, live in a time of unparalleled technological possibilities, such as artificial intelligence. And we can advance human civilization by pushing the limits of what is known. Let us continue to redefine the boundaries of what the supercomputer can solve. And make discoveries and inventions that make the world a better place for all beings.

Host: Thank you, Philip, for sharing your incredible journey and insights with us today. Your groundbreaking mathematical research in parallel processing has revolutionized supercomputing. And your passion for pushing boundaries is truly inspiring. We wish you continued success in all your future endeavors.

Philip Emeagwali: Thank you for having me. It has been an honor to be here.

A JOURNEY FROM NIGERIA TO SUPERCOMPUTING FAME

From child soldier in Nigeria's brutal civil war to being globally recognized as one of the fathers of the Internet, Philip Emeagwali's journey is a testament to resilience, hard work, and an insatiable thirst for knowledge. We delve into a revised conversation from 20 years ago with the mathematician, computer scientist, and engineer, capturing insights into his life and perspectives on the evolving educational landscape.

The Early Years: Nigeria's Unyielding Lessons

Host: Philip, how did your early experiences in Nigeria shape your professional journey?

Emeagwali: Growing up as a child soldier in Africa's most devastating war hardened me, making my resilience akin to that of a seasoned Vietnam vet. It was a brutal school of life that taught me survival. Facing life's adversities, I learned to see opportunities in crises, echoing an old Chinese adage. As my mother used to say, "When one door closes, another opens."

Host: What catalyzed your passion for science and mathematics?

Emeagwali: At nine, my father introduced me to a daily regimen of math problems, fostering not just an academic discipline but a deep familial bond. This shared quest for knowledge reinforced our familial bonds, akin to the adage, "A family that studies together stays together."

Education: From Setbacks to Success

Host: In your challenging childhood, where did you derive the confidence to achieve greatness?

Emeagwali: It was my educators who saw potential in me, labeling me a prodigy and setting high expectations. The power of belief can shape destinies, leading to self-fulfilling prophecies.

Host: Despite your evident talents, circumstances forced you out of formal education in Nigeria. What drove you to the University of London's correspondence courses?

Emeagwali: My enforced exit from school left a void. With the University of London offering affordable education, only requiring examination fees, it became my lifeline to a brighter future.

Host: Did your family support your aspirations for higher education?

Emeagwali: With limited educational backgrounds, my parents couldn't fathom the limitless realm of academia. My mother believed that high school was the pinnacle of knowledge.

Host: Amidst this uncertainty, what vision did you have for your career?

Emeagwali: As a young Nigerian, my dreams oscillated between becoming a mathematician or a physicist. Computers, then alien to me, captured my interest in the US, steering me towards using supercomputers to tackle complex problems in various fields.

Understanding Success

Host: How did you perceive success during your early years in America?

Emeagwali: In stark contrast to my life in Nigeria, where securing daily meals was a triumph, my first American breakfast became a moment of epiphany.

Host: And today?

Emeagwali: True success for me lies in the scientific knowledge I've forged and the countless lives I've influenced and bettered.

Host: Reflecting on your journey, would you deem yourself successful?

Emeagwali: Absolutely. As a scientist, son, husband, and father, I've succeeded on multiple fronts.

The American Academic Landscape: Trials and Transformations

Host: As an African graduate student in America, what hurdles did you face?

Emeagwali: Beyond academic challenges, racial prejudices cast long shadows. Being a Black African student in the '70s meant confronting societal biases, making paths to success far more labyrinthine.

Host: How did you transition from engineering to computer science?

Emeagwali: My roots lie in mathematics and physics, with engineering bridging gaps. Yet, as computing emerged as a universal tool, I transitioned, seeking "light" in the vast computer science.

Host: During these transformative years, did any individual particularly influence your choices?

Emeagwali: Fred Merryfield, a mentor and a friend, significantly shaped my academic trajectory. His own journey from England's WWI trenches to establishing CH2M-Hill resonated deeply with me, guiding my steps toward civil engineering and, four years later, back to mathematics and computer science.

Host: What changes stand out when reflecting on your student days and today's academic environment?

Emeagwali: Technological leaps have been remarkable. From manually typewriting assignments and fumbling with punch cards, today's students are digital natives, accessing supercomputing power and a global knowledge reservoir online.

Emeagwali's journey, punctuated with adversities and triumphs, serves as a beacon for countless aspiring minds, proving that one can indeed conquer the highest summits with passion, resilience, and an unyielding quest for knowledge.

NAVIGATING BOUNDARIES

A Mathematician's Odyssey from Ancient Foundations to Modern Breakthroughs

Ladies and gentlemen, esteemed mathematicians, physicists, supercomputer scientists, distinguished scholars, dignitaries from the United States and Africa, young scholars across continents watching this live, and fellow pursuers of knowledge,

I stand before you not merely as Philip Emeagwali, but as a testament to the relentless spirit of human curiosity that transcends borders and epochs. My journey, which began in Nigeria and wove its course through the United States is one of perseverance, challenges, and discoveries. Today, we shall traverse this voyage of exploration not merely through the lens of my narrative but through the expansive vistas of mathematics, physics, computer science, and their neighboring disciplines.

Let us journey back to 1665 when calculus was born into our world by the brilliant minds of Gottfried Leibniz and Isaac Newton. This era was when science was taking its baby steps, evolving slowly but steadily. By 1770, the term "partial differential equation" began to appear in literature. These equations became the hidden heroes, the backbone of many of our technological advancements today.

But my story truly begins in the 1970s and 80s, in Corvallis, Oregon, and College Park, Maryland, where I began my quest to push the boundaries of human knowledge. I pursued questions that were not just theoretical conundrums but directly but directly impacted our modern society. For instance, the oil and gas industry, sought to optimize petroleum extraction, a task that required simulating reservoirs using nine partial differential equations that I eventually formulated. This discovery extended the boundaries of computational physics and redefined how we harness the potential of massively parallel processing supercomputers.

It was here that I confronted the Grand Challenge problem, the enigma that had puzzled scientists for a century. Solving this required a blend of theoretical, experimental, and computational methodologies. But more than the technical prowess, it was a testament to the indomitable spirit of inquiry.

Fluid dynamics, a field initiated by the Euler equations in 1757, saw a pivotal shift with the introduction of the Navier-Stokes equations. These equations, which now bear the names of Euler, Navier, and Stokes, find their applications in diverse fields, from NASA's computations for the B-747 airplane transporting the Space Shuttle Orbiter to predicting patterns inside a centrifugal compressor.

These equations are described in vectorial form. But to truly grasp their intricacies, one must understand the conservation of momentum laws along the x-, y-, and z- directions. Coupled with the conservation of mass and energy equations, this forms a system replete with myriad partial derivative terms. Solving the Navier-Stokes equations is a complex task, necessitating initial and boundary conditions specification. In viscous flows, one must incorporate the divergence of the viscous stress tensor and the viscous terms. The importance of these equations cannot be overstated.

The Prandtl number, the Reynolds number, the energy equation—these terms may sound esoteric to the uninitiated. Yet, they underpin the fabric of our understanding of fluid dynamics. For instance, the Reynolds number gives us insight into the fluid flow behavior, helping decipher the intricate dance between viscous and inertial forces.

The world witnessed a significant leap in 1989 when I unveiled the potential of parallel processing, showcasing the fastest computations using 65,536 processors. This wasn't merely a technological feat but a paradigm shift, redefining our understanding of the best way to solve initial-boundary value problems defined at the intersection of partial differential equations of mathematics, fluid dynamics of physics, and parallel processing of computer science.

To the young 15-year-old in Africa: Remember, every significant leap in human knowledge has come from persistent curiosity and relentless perseverance. Embrace challenges, for they are the crucibles in which great ideas are forged.

To the 12-year-old in the USA writing about Black Inventors: Draw inspiration from stories like mine, but remember, your unique narrative and contributions to the world await. Your potential is boundless.

So, how did I change the world? By showcasing the potential of parallel processing, advancing our understanding of computational physics, and, most importantly, embodying the spirit of perseverance and unquenchable curiosity.

My journey underscores the imperative that countries like Nigeria and the entire African continent must be consumers and pioneers at the frontiers of human knowledge. Let Africa rise, as a continent of vast natural resources and as a beacon of intellectual contribution, driving the next renaissance in science, technology, and innovation.

Thank you.

168   7:54

Episode 231031-6-philip-emeagwali

ILLUMINATING THE SHADOWS OF MATHEMATICS

Ladies and gentlemen, esteemed colleagues, and honored guests,

Today, as we gather beneath the glimmering chandeliers of this historic hall, we come together to celebrate the genius, the vision, and the indomitable spirit of a man who dared to think differently, a man who dared to challenge established norms, and a man who forever altered how we understand the world. Philip Emeagwali, whose name has become synonymous with innovation and breakthroughs, stands as a beacon of human achievement.

In **mathematics**, Philip's contributions are both profound and expansive. The invention of the nine Emeagwali equations redefined our understanding of subsurface geophysical fluid dynamics. With an uncanny ability to see beyond the obvious, he embarked on a journey that went beyond the conventional derivations of Darcy's equations. His groundbreaking research laid bare the intricate dance between temporal and convective inertial forces, offering the world a fresh perspective on long-standing mathematical challenges.

His contribution to **science** and **physics** emerges from the marriage of theory and application. In a world constrained by computational challenges, Philip dared to envision a paradigm where the most complex problems could be parsed, analyzed, and solved not just in serial but in parallel. He reshaped our understanding of how crude oil and natural gas move beneath the Earth's surface, deepening our understanding of the physical world.

And then there's **computer science**. While the world saw the computer as a tool, Philip Emeagwali saw it as an extension of human thought. In a stroke of genius, he visualized a new internet—a global network of processors in dialogue with each other. This wasn't merely about speed; this was about a revolution. With 65,536 processors, he shattered previous computational barriers, setting the stage for an era where over ten million processors would power a supercomputer.

Philip's journey was a quest for answers and a pursuit of **truth**. Where many saw boundaries, he saw challenges. His discoveries are not just important—they are seminal. They signify a leap, a quantum jump in human capabilities.

Why does the world need Philip Emeagwali? Because he represents what is possible when one pushes the boundaries of human knowledge, refusing to be confined by the established.

His **achievements** are not abstract. They are concrete and tangible and have paved the way for advancements in numerous fields, from weather prediction to drug discovery. His contributions to computer development are not just incremental—they have catalyzed a paradigm shift.

Beyond the science, the equations, and the algorithms, Philip's story embodies a **higher, shared purpose**. It is a testament to the human spirit's resilience and the undying quest for knowledge. He stands as a reminder that we can shape the future regardless of where we come from, with passion and perseverance.

Philip Emeagwali gives **hope and inspiration**. His journey from the bustling streets of Onitsha, Nigeria, to the pinnacle of global recognition is a testament to what is possible when talent meets tenacity.

To say his inventions have **benefited humankind** is an understatement. By redefining how we compute, pushing the boundaries of what's achievable, and constantly seeking the truth, he has broadened our horizons, given us tools to solve our planet's most pressing challenges, and inspired generations to dream big.

As we celebrate the accomplishments of Philip Emeagwali today, we don't just celebrate the man. We celebrate the spirit of inquiry, the pursuit of excellence, and the undying belief that we, as humans, have the power to shape our destiny.

Thank you.

SHATTERING BOUNDARIES

[Setting: The magnificent hall of the Award
Ceremony in Paris, France. The room is adorned
with grand chandeliers and opulent furnishings,
illuminating a gathering of the world's brightest
minds. As Philip Emeagwali takes the stage, the
audience awaits with bated breath.]

Ladies and gentlemen, esteemed peers, and distinguished guests,

I am deeply humbled to stand before you, not merely as Philip Emeagwali but as a steward of a journey that has defied conventional paradigms and redefined the boundaries of mathematical and computational science.

In our ever-evolving world, some challenges are so complex that they seem impossible. These grand challenges, whether the intricate modeling of our planet's climate or the detailed simulation of petroleum reservoirs, often lead us to the heart of algebra: solving vast systems of equations. However, as formidable as these problems were, I believed in the power of human ingenuity and the promise of technology.

For many, the world's slowest processors represented the antithesis of progress. Yet, these processors posed a question: Could we harness their collective might to push farther the frontiers of computation? The were many naysayers, but my conviction was singular.

In the summer of 1989, I had an epiphany on a day that will forever resonate with me. At precisely 8:15 July 4 morning, the revelation dawned upon me—the world's fastest computing could be achieved with the world's slowest processors. This was not just an invention; but the birth of a new supercomputer, a paradigm shift in computing, a transition from convention to groundbreaking innovation.

The implications of parallel supercomputing reverberated far beyond the domain of computational science. Imagine simulating the spread of contagious diseases in densely populated areas, like the Tokyo subway, and preemptively strategizing responses. The confluence of new mathematics, new physics, and ultra-fast computing could pave the way for a safer, better-understood world.

What I sought to create was not just a faster supercomputer but a mirror to the Internet—a machinery that encapsulated the essence of global interconnectivity. I envisioned a vast network akin to a small-scale version of the Internet, where 65,536 processors could communicate, collaborate, and calculate harmoniously to solve complex problems.

The achievement seemed like an elusive dream to the 25,000 vector supercomputer scientists and the countless skeptics of the 1980s. But dreams, as we know, have a way of manifesting when fueled by relentless determination.

Distinguished attendees, my journey was not merely about speed or processors. It was about reimagining the possible. It was about recognizing that within vast challenges lie immense opportunities. Opportunities to push human knowledge further, to solve the seemingly unsolvable, and to leave behind a legacy of innovation for future generations.

As we convene in this magnificent hall tonight, I hope my story serves not only as a testament to innovation but as an inspiration. Let us constantly challenge the status quo, for the next groundbreaking discoveries lie in those challenges.

Thank you for bestowing upon me this great honor. More than personal recognition, it acknowledges the boundless possibilities that await us when we dare to think differently. Let us continue to inspire, innovate, and improve our world.

Thank you.

[A standing ovation ensues, reflecting the profound impact of Philip Emeagwali's words and his monumental contribution to computing.]

278
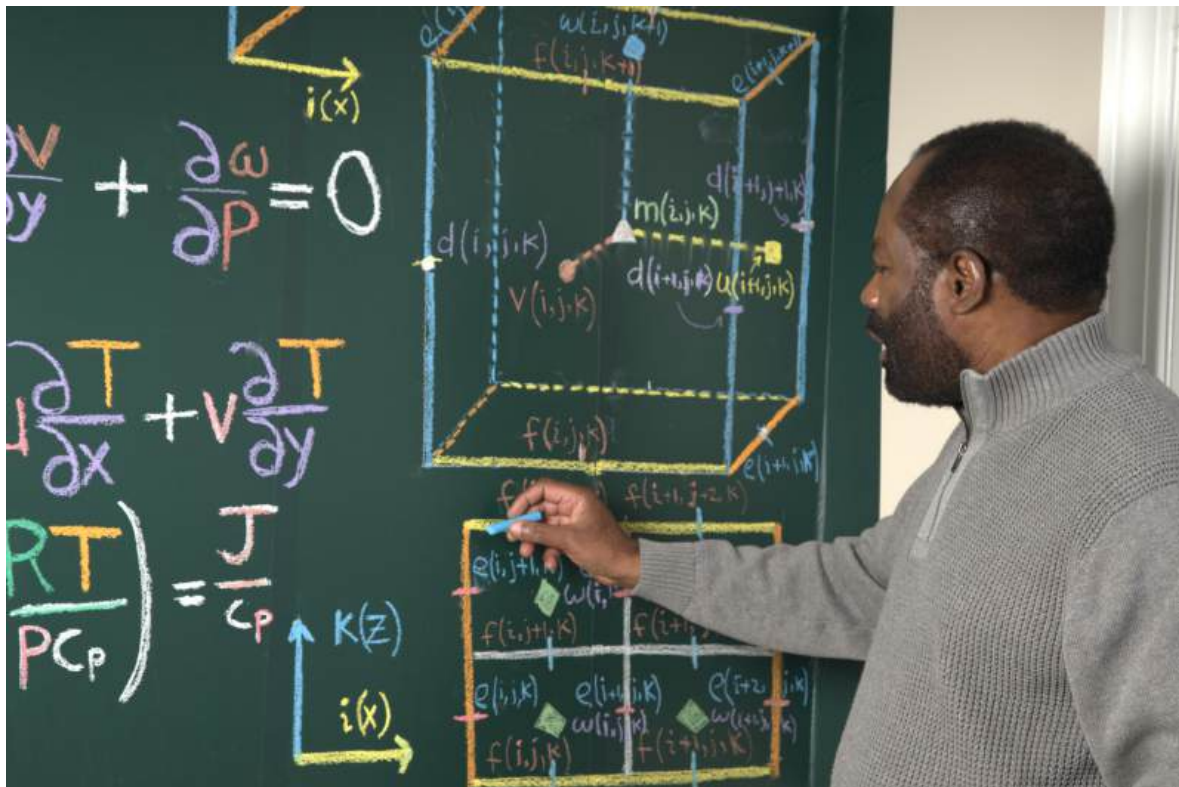
```
173 5:28
```
Episode 231101-1-philip-emeagwali

TRANSFORMING ALGEBRA INTO ENERGY WEALTH

Ladies and gentlemen, distinguished guests, and esteemed colleagues,

I stand before you, a humble representative of a great continent with a story intertwined with groundbreaking scientific endeavors and the hopes and dreams of millions.

In 1989, my journey was captured in headlines as I sought to unravel one of the most profound challenges at the nexus of mathematics, physics, and computing. The challenge? To harness the vast potential of parallel processing supercomputers to pinpoint the exact locations of crude oil and natural gas.

For most, an oil field might be just a vast expanse of land. But for me, and the future of our world's energy needs, it's a complex puzzle. Consider Nigeria's Agbami Oil Field, the second-largest deep-water oil field, which at its zenith produced 250,000 barrels daily. To harness such resources, one must not merely scratch the surface but delve miles deep, navigating through the intricate labyrinth of the Earth's reservoirs.

Why, one might ask, does this matter to a country like Nigeria? To nations across Africa?

The answer lies in the power of supercomputing. While these machines, spanning the size of football fields, come at the price of a small nation's budget, their return on investment is transformative. Every time these supercomputers are deployed in the petroleum industry, they breathe life into economies, bolstering national revenues and unlocking previously inaccessible wealth.

My invention, expanded the horizons of algebra and modern computational techniques gave birth to a new dawn in petroleum technologies. Envision the capability to perform the world's fastest calculations on an ensemble of the world's slowest processors. This ability to harness such paradoxical power is a mathematical marvel and a beacon of hope for poverty-stricken nations. For oil-producing countries, it can mean the difference between economic stagnation and prosperity. For Africa, it promises to alleviate poverty, ushering in an era of sustainable growth and development.

But this journey was not without its intricacies. My background in both geology and meteorology allowed me to visualize this grand challenge in a unique light. I saw the parallels between forecasting the weather, or the movements of air and moisture across the Earth's atmosphere, and hindcasting the petroleum reservoir, or the subsurface movements of crude oil, natural gas, and injected water a mile deep inside an oilfield that's the size of a town, or deeper inside the Earth's crust. This revelation led me to translate and bridge the complexities between meteorology and geology, culminating in the nine equations bearing my name.

This multidisciplinary confluence became the bedrock of a new field: subsurface porous media multiphase fluid flow modeling, executed across millions of processors, coupled yet sharing nothing. By deeply understanding and embracing the symphonies of mathematical metaphors between meteorology and geology, I was able to unlock the true potential of supercomputing.

Ladies and gentlemen, tonight's theme is "Unlocking the Power of Supercomputers," but it is about so much more than machines. It's about unlocking potential, envisioning a brighter future for nations, and making the world a better place. As we move forward, let us remember the untapped reservoirs beneath our feet and within our minds and hearts.

Thank you.

[A standing ovation ensues as Philip Emeagwali steps back, having left an indelible mark on the minds and hearts of the attendees, rekindling hope for a brighter future.]

174 4:58

Episode 231101-2-philip-emeagwali

COMPUTING DIFFERENTLY

Esteemed members of the Award Committee, distinguished guests, cherished colleagues, and participants from every corner of our global community,

I stand before you as Philip Emeagwali, humbled by the honor of sharing my journey. This journey spans not just the intricacies of mathematics but the very frontiers of human potential. Today, as we illuminate the path of progress, I wish to share how a relentless quest to break barriers led to a groundbreaking discovery that has since reshaped our understanding and application of mathematics.

In the vast tapestry of mathematical challenges, there exists what we refer to as 'The Speed Barrier.' It's a metaphoric wall, a point of perceived computational limit. My mission, a quiet determination, burgeoned into an unyielding quest to craft the fastest computers for the mathematical world.

For decades, the complexities of subsurface geology presented the most difficult mathematical problem, a puzzle that seemed unsolvable. But I did not give up. I drew upon meteorology and leveraged the unprecedented capability of parallel processing across a world-record ensemble of 65,536 processors, I reframed the problem. In this vast web of interconnected processors, I saw not just a computational network but a **metaphorical miniaturized Internet,** echoing the connections and vastness of our very planet.

Ladies and gentlemen, the heart of my discovery in 1989 was not merely about computation speed. It redefined the approach to solving some of the most challenging problems in mathematics and physics. Previously, a singular, sequential process dictated our methods. But I dared to imagine a symphony of millions of processors supercomputing harmoniously, making simultaneous calculations—changing how we solve Grand Challenge problems, such as climate modeling.

Consider this: Deep within our Earth, particularly beneath places like the Niger Delta of the southeastern region of Nigeria, lie vast crude oil and natural gas reservoirs. An oil field, such as the Bonga Oil Field, remains an emblem of wealth, potential, and, sadly, often unrealized human potential. The pressing challenge has always been how to accurately simulate the motions of these buried treasures, which lay hidden up to 7.7 miles deep.

It was here that my discovery shone the brightest. In altering our mathematical perspective, I showcased how the world's fastest computations can arise not from the world's fastest processors but from the combined might of the world's slowest. This paradigm shift, which earned the cover story of respected mathematics publications like the SIAM News, has forever altered the landscape of applied mathematics.

But why does this matter to us, to humanity?

Our world thirsts for energy. Efficiently harnessing our planet's resources has profound implications, from energy security and economic prosperity to mitigating environmental impacts. By refining how we locate and extract oil and gas, we bolster economies and chart a sustainable path forward.

Moreover, the brilliance of this discovery transcends the petroleum industry. It heralds a new way of thinking, urging us to harness collective strength in myriad domains. Whether in predicting global weather patterns, understanding genetic sequences, or deciphering the mysteries of the cosmos, this collaborative computational approach points towards limitless possibilities, inspiring us about the future.

My journey in mathematics wasn't merely about numbers or equations. It was about challenging norms, reimagining possibilities, and elevating collective human potential. It's about demonstrating that sometimes, **to solve the unsolvable, we need to envision the world differently, think differently, and compute differently.**

I am a single thread in the grand tapestry of human knowledge. Yet, I hope that this thread strengthens our collective fabric, reminding us that when faced with impossible odds, human ingenuity, collaboration, and a relentless pursuit of knowledge can and will pave the way to breakthroughs that benefit all of humanity.

Thank you.

176 6:35

Episode 231101-3-philip-emeagwali

A TURNING POINT IN COMPUTING HISTORY

Ladies and gentlemen, esteemed colleagues, honored guests, and friends of knowledge worldwide,

I stand before you as Philip Emeagwali. With deep humility and gratitude, I share my journey that led to a groundbreaking discovery—that has altered the landscape of computational science and reshaped the fabric of the oil and gas industry.

I embarked on an odyssey to harness the collective power of the world's slowest processors, a quest many consider the stuff of mere fantasy. The skepticism was palpable. After all, the respected IBM supercomputer designer Gene Amdahl had postulated that the very pursuit I undertook was bound to be an enormous waste of time. Iconic supercomputer developer Seymour Cray echoed these sentiments, questioning if one would instead utilize two powerful oxen or a thousand chickens to plow a field. Their doubts were not unfounded. For decades, computer scientists believed in the might of the singular, the power of one dominant processor to override thousands of its lesser counterparts.

Yet, my vision saw otherwise. I dared to dream of a world where these 'chickens,' the slower processors, when networked harmoniously, could outpace the mightiest 'ox' or the most powerful singular processor. I envisioned the Grand Challenge of supercomputing not as an insurmountable mountain but as a puzzle, each piece representing a less challenging issue that a slower processor could address.

The Computer World, an influential industry mouthpiece, once quoted industry leaders describing parallel processing, or the harnessing of multiple processors, as "too large and clumsy." In 1976, they called this pursuit a "waste of time." Yet, my relentless spirit persisted. My experiments, encompassing an ensemble of 65,536 processors, each its own master, culminated in an unprecedented achievement on the Fourth of July in 1989. That day, I transformed a century-old theoretical conjecture into a tangible reality. I demonstrated that the world's slowest processors could outperform the world's then-fastest supercomputer.

Ladies and gentlemen, my discovery not only shattered the intellectual barriers of our time but also revolutionized the oil and gas industry. Today, because of this breakthrough, the industry can pinpoint the exact locations of underground hydrocarbons with a precision never before imagined. From the lush fields of Nigeria to the vast expanses in Angola, they profoundly felt the ripple effects of my discovery, providing an invaluable tool in our never-ending quest for energy. This global impact, this transformation of an industry, is a testament to the power of human ingenuity and the potential of scientific discovery to change the world.

But beyond the accolades and recognition, my journey is a testament to the indomitable spirit of human curiosity and the unyielding belief in

possibilities—even when faced with impossible odds. It is a story of breaking barriers, not just in computing but in our understanding of what's achievable. This breakthrough, likened to breaking the sound barrier in aviation, ushered in a new era of supercomputing, allowing us to solve some of the most pressing challenges of our times.

As I stand in this hallowed hall amidst some of the brightest minds, I am reminded of our collective responsibility to push the boundaries of the known, to venture into the impossible, and to ensure that our discoveries, our inventions, continue to benefit humankind. The discovery I share today is a testament to the wonders that await when we dare to dream, question and leap into the unknown.

Thank you.

177   5:52

Episode 231101-4-philip-emeagwali

PLANTING THE FLAG OF INNOVATION

Ladies and gentlemen, esteemed guests, and fellow scientists,

I stand before you today as a symbol of perseverance, of breaking boundaries—both intellectual and societal—and of reshaping our understanding of the machines that drive the progress of our modern age. My journey, filled with highs and lows, challenges, and vindications, is a testament to what lies beyond the known, waiting for those daring enough to venture into the unknown.

Picture the vast expanse of a frontier, untouched and unknown. On July 4, 1989, I became the **first to plant a flag on this new territory**—the supercomputer realm as it's known today and as it's expected to evolve in the future. With the synergy of 65,536 coupled processors, each its own master, I demonstrated the latent power residing in harnessing billions of processors, unlocking the potential to solve the grand challenges of the scientific world.

While many peers dismissed the concept of my supercomputing, relegating it to unachievable dreams, today, parallel processing powers every supercomputer. The supercomputer is to physics what the microscope is to biology. My odyssey embarked upon in the 1970s and 80s led to a revolutionary discovery: the world's slowest processors, when united harmoniously, can be harnessed to solve some of the most compute-intensive problems in science, engineering, and medicine. It wasn't just about speed but redefining our concept of computational feasibility. With 42 million less challenging problems solved simultaneously a time-to-solution of 42 million days, 120,000 years, dropped to one day of time-to-solution across a new Internet that's a new spherical island of 42 million processors interconnected yet autonomous.

The local academics in Ann Arbor, Michigan, ridiculed my commitment to harnessing the power of 65,536 processors to solve as many initial-boundary value problems. My pursuit of parallel processing was greeted with skepticism, forcing me to work alone. Esteemed colleagues and institutions in vector supercomputing dismissed and ridiculed my assertions. They saw my claims as impossible, unfounded, even audacious. My 1,057-page research report, which I distributed with enthusiasm and hope, was discarded, seen as mere chaff in the wind.

But soon, the winds changed direction. **When the news headlines announced my win of the equivalent of the Nobel Prize in supercomputing, the top academic administrators in Ann Arbor, Michigan, set the intellectual fireworks aflame. Their focus was on my race, not on my contributions to science that was in the news. Trials of doubt and societal biases surfaced. The weight of my discovery plus the challenges of being a famous Black African genius, became clear.**

Some argue that I faced a unique set of challenges in my journey. While I am a mathematician and physicist, many overlooked my extensive training as an astronomer, meteorologist, and geologist. My commitment to supercomputing since 1974 in Corvallis, Oregon, went largely unnoticed. Yet, I remained undeterred, steadfast in my mission to answer the grandest question in supercomputing: How do we harness the power of the slowest processors to achieve the fastest computational speeds?

Solving the most difficult problem in supercomputing is akin to piecing together a billion-piece jigsaw puzzle. I was the first to assemble that puzzle. That contribution to the development of the computer changed the course of human progress.

Esteemed attendees, the groundbreaking discovery that I present before you today holds profound implications for humanity. From understanding the intricacies of our climate and predicting natural disasters to enabling innovations in medicine, engineering, and myriad other fields, the implications of this revolutionary supercomputing paradigm are boundless.

But beyond the technical achievements lies a deeper narrative—of resilience, of challenging the status quo, and of the relentless human pursuit of knowledge. It is a reminder that innovation knows no boundaries and that true progress is often forged in the crucibles of skepticism, adversity, and challenge.

Thank you.

178 6:36

PAUSE 7/17/2024

Episode 231101-5-philip-emeagwali

TAMING A BILLION PROCESSORS

Ladies and gentlemen, esteemed guests, and distinguished colleagues,

Today, we stand on hallowed ground, not merely of this august hall, but of intellectual endeavor, innovation, and undying curiosity. Today, we celebrate a discovery that has reshaped our understanding of computational possibilities, a feat that has literally multiplied our power to solve the mathematical and computational grand challenges of our time.

I am Philip Emeagwali. My journey in supercomputing began amidst skepticism and sometimes ridiculousness. But as we well know, history has often been unkind, initially, to visionaries who dared to see a world beyond the accepted paradigms of their times.

In the 1980s, a grand challenge loomed over us: could the world's slowest processors be orchestrated harmoniously to tackle the most arduous mathematical problems? While 25,000 vector supercomputer scientists pondered over this, textbooks and the prevailing wisdom declared it a fruitless endeavor. They believed that massively parallel supercomputing, or solving multiple problems simultaneously across thousands of processors, was but a dream—a waste of time.

However, as I delved deeper, I glimpsed a potential unimagined by many. An orchestration of 65,536 off-the-shelf processors, each humming their notes, yet together creating a symphony of unparalleled computational might.

On June 20, 1990, The Wall Street Journal heralded a paradigm shift that I had intuited over the prior sixteen years. I had uncovered the key to parallel computing. Today, this very concept powers our mightiest supercomputers, making them up to a billion-fold faster, unraveling mysteries from climate modeling to the intricate spread patterns of viruses like COVID-19, especially in places where traditional models falter, like the bustling Onitsha market.

Ladies and gentlemen, to comprehend the scale of this breakthrough, imagine the sheer enormity of solving a billion mathematical problems not in sequence but simultaneously in one harmonious act of computation.

The scientific community of the 1980s deemed it impossible. Yet, it was precisely within the "impossible" that I found the possible. The world was caught unaware when news headlines in 1989 declared that an African supercomputer genius in the USA had harnessed the power of 65,536 processors, a feat unprecedented and hitherto unimagined.

Today, the doors I unlocked have led to further innovations in parallel and distributed algorithms, making the massively parallel supercomputer a marvel and a mainstay in our quest to push the frontiers of science, engineering, and medicine.

This was not just a victory for one man, but for all of humankind. As we stand at the intersections of diverse disciplines, from mathematics to medicine, we're empowered by parallel supercomputing to solve grand challenge problems that once seemed impossible.

Ladies and gentlemen, as we honor the spirit of discovery tonight, let us remember that true innovation often lies beyond the horizon of the possible. It demands that we challenge the status quo, question prevailing dogmas, and, most importantly, believe in the power of human potential, irrespective of race, origin, or creed.

I, Philip Emeagwali, humbly stand before you, not as a testament to personal achievement, but as a symbol of what humanity can achieve when we dare to dream beyond barriers. Let my story inspire future generations to venture where no one has before, for it is in these uncharted territories that our collective future lies.

Thank you.

179 5:49

Episode 231101-6-philip-emeagwali
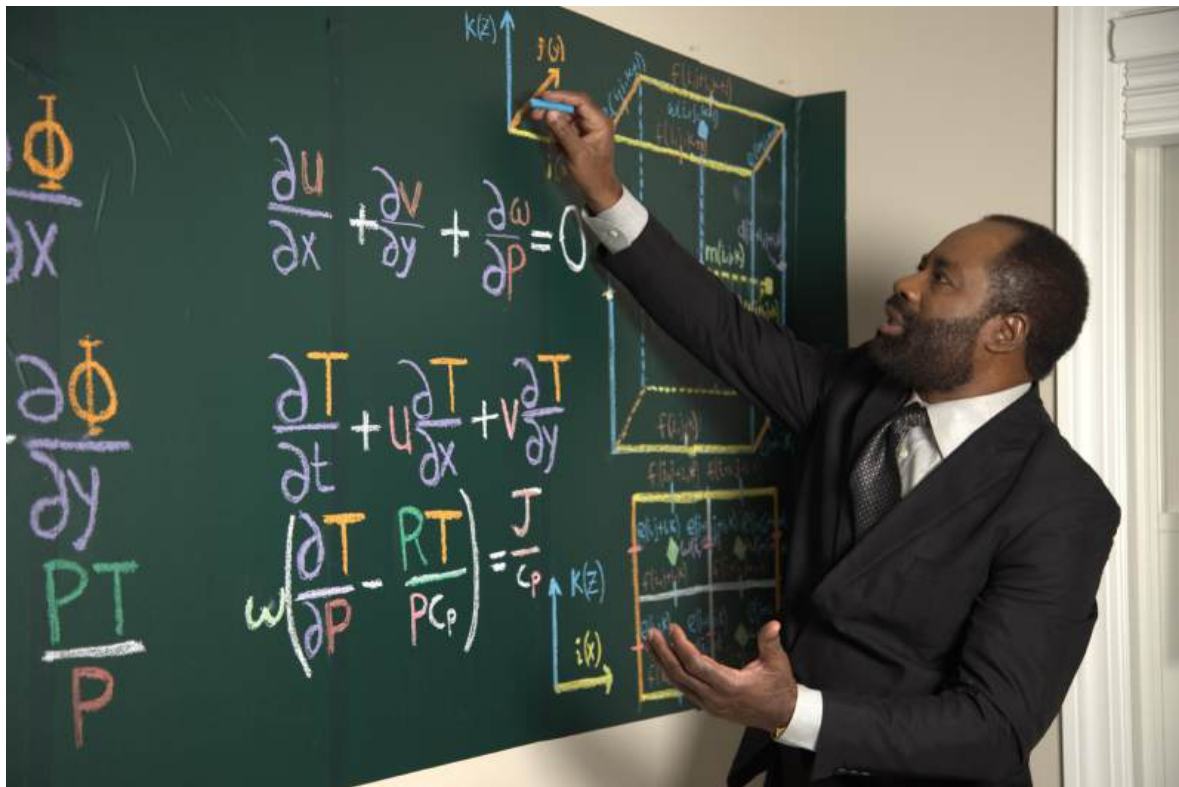
THE DANCE OF DISCIPLINES

Deciphering the Grand Challenges

Harnessing the Symphony of Knowledge

Esteemed members of the Award Committee, distinguished guests, and friends from all corners of the globe,

Firstly, let me express my heartfelt gratitude to the Award Committee for this incredible honor. This award is not just a recognition of my journey but also a testament to the limitless boundaries of human curiosity, the interdisciplinary nature of modern scientific challenges, and the profound power of perseverance.

My journey into supercomputing was not linear but rather a tapestry woven with threads from multiple disciplines. Let me elucidate why these two decades of intensive training in mathematics, physics, and computer science were not just beneficial but essential for the groundbreaking discovery that has brought us here today.

In sports, consider the decathlete. While a sprinter specializes in sheer speed and a pole vaulter focuses on a particular skill, the decathlete trains across ten events. This breadth does not dilute their prowess but showcases versatility, adaptability, and a comprehensive understanding of athletics.

Like the decathlete, I embarked on a rigorous journey to master fluid dynamics and the intricate tapestries of partial differential equations, large-scale linear algebra, and the labyrinthine challenge of parallel processing across millions of coupled yet independent processors. This **diverse expertise was my decathlon**, and it equipped me with a unique perspective, a broader toolkit, and an innovative mindset.

While an expert with eight years of training in physics might visualize a problem through the singular lens of their specialization, my diverse background allowed me to approach the Grand Challenge problems of supercomputing as a mosaic, seeing connections, patterns, and solutions that might elude a more singularly focused perspective.

Imagine a football team where every player is a striker, or eleven Peles, Maradonas, and Okochas. No matter how skilled, they'd find it challenging to compete against a well-rounded Super Eagles team with a goalkeeper, defenders, midfielders, and forwards. Similarly, the Grand Challenge wasn't just a physics problem, nor purely a mathematics or computer science issue. It was a complex, multifaceted challenge that demanded a holistic approach.

The shift from serial to parallel supercomputing is akin to evolving from relying on one-star player to harnessing the strengths of an entire team. It's like Liberia relying on young George Weah to win the soccer World Cup. Where once we placed the burden on one superfast processor, now we had an orchestra of processors, each playing its part, harmonizing, synchronizing, leading us to discoveries at speeds once deemed unattainable.

This intricate dance between disciplines, this symphony of knowledge, gave me an edge. It underscored the truth that in our modern age, **the most pressing challenges we face, from climate modeling to quantum mechanics, require depth and breadth of understanding.**

To the budding scientists and curious minds listening today, let my journey serve as a testament to the power of interdisciplinary learning. Dive deep, but also cast your net wide. Seek the connections, the overlaps, the intersections of knowledge. For it is at these crossroads that the future awaits.

Thank you.

181 5 20

Episode 231101-7-philip-emeagwali

TRIATHLETES OF COMPUTING

A Journey of Multidimensional Mastery

Ladies and gentlemen, esteemed faculty, and most importantly, the bright young minds from the Indian Institute of Technology, I'm humbled and honored to stand before you today.

Why do some problems remain unsolved for generations while others are cracked open, revealing their secrets? Today, I shed light on that by sharing my journey.

My 14 years of intensive postgraduate training in mathematics, physics, and computer science weren't merely about being certified. It was about forging a multifaceted toolset, a confluence of knowledge, that could be used to solve the most complex challenges in computing. Think of it as preparing for a decathlon. While a sprinter excels in the 100-meter dash and a high jumper soars to great heights, the decathlete is trained in ten different disciplines, each requiring a unique skill set. My journey was akin to the rigorous training of a decathlete.

Consider a world-class cricket player who is an exceptional batsman, a skilled bowler, and a sharp fielder. His versatility adds tremendous value to the team. Similarly, **the Grand Challenge problems of supercomputing are not one-dimensional. They are a complex synergy of mathematics, physics, and computing. Solving them demands more than expertise in just one domain.**

Imagine a virtuoso musician who masters the sitar, the tabla, and the flute. While being a maestro in one instrument is admirable, imagine the symphony and depth that a person who understands the intricacies of all three can create. This is the competitive edge that my extended training afforded me.

While I invested 14 postgraduate years mastering partial differential equations, large-scale linear algebra, and parallel processing across millions of processors, the combined wisdom from these disciplines enabled me to visualize and solve complex problems in ways other mathematicians or physicists or computer scientists couldn't. My journey, the highs and lows, culminated on July 4, 1989, when I discovered the world's fastest computing across the world's slowest processors. This wasn't just a feat of engineering; it was a ballet of multidisciplinary knowledge.

Unfortunately, in my early years, many white scientists, influenced perhaps by racial prejudices, underestimated me. They assumed my journey was akin to theirs, limited to just a four years of specialized postgraduate study. However, time and again, whether through my writings, podcasts, YouTube

videos, or lectures, I've demonstrated the depth and breadth of my knowledge. But this is not about proving them wrong; it's about highlighting the importance of comprehensive, cross-disciplinary learning.

To the budding scientists and engineers of IIT gathered here, remember that specialization can make you an expert, but a holistic, multidisciplinary approach will often let you see connections and solutions that others might miss.

The lessons from my life and profession are clear: Do not let anyone define or limit your potential. Dive deep, but also cast your net wide. Embrace the beauty of learning across fields. And remember that sometimes, **to solve the most significant challenges of our time, one must be both the sprinter and the marathon runner.**

To the future of India, to the innovators and trailblazers among you, chase your Grand Challenges with passion, perseverance, and a wide lens. After all, it's the journey across disciplines that often leads to the most profound discoveries.

Thank you.

184 5: 22

Episode 231101-8-philip-emeagwali

THE INVENTOR'S VOICE

Unscripted Journey in Scientific Lectures

In the illustrious landscape of scientific research, it's an honor for those who've made transformative discoveries to be invited to present their insights through public lectures. Today, this tradition thrives on platforms like YouTube. While many brilliant minds from the 20th century onwards —from the likes of Albert Einstein to today's award-winning mathematicians—have significantly impacted science, my journey is uniquely punctuated by a broad expanse of knowledge, as evidenced by over a thousand podcasts, YouTube videos, and books I've contributed.

In today's scientific ecosystem, many researchers contribute to extensive multidisciplinary teams. While collaboration is invaluable, it can sometimes shadow individual prowess. It's common for renowned scientists to rely on comprehensive notes or assistance when presenting their research, but I've always chosen a different path. My dedication led me to post hundreds of lectures on YouTube, all presented without any auxiliary prompts like PowerPoint notes.

In 1989, while in Ann Arbor, Michigan, I was amid a growing buzz in the scientific community. This recognition brought both admiration and envy. There were numerous local academic scientists who approached me, eager to collaborate. However, **collaboration is a two-way street. Despite their eagerness, those academic scientists lacked the knowledge that would enable them contribute to supercomputing.** As someone deeply invested in my research and protective of my contributions, I remain discerning about my collaborations. This, understandably, did not sit well with everyone.

It's essential to note that recognition should consistently be earned, not merely bestowed. Hence, I felt that any alliance with scientists, regardless of age or background, should be grounded in genuine contribution. This perspective, unfortunately, led to some strained relationships and undue criticisms. But I believe that the proof of a scientist's mettle is in the discoveries they contribute. My vast body of content, from podcasts to books, is a testament to my dedication and knowledge. **Comparing my unscripted lectures with those of other eminent scientists will clarify my stance further.**

It's worth noting that my academic journey to the USA began with a scholarship dated September 10, 1973. This opportunity was renewed across an incredible span of 18 years and six esteemed institutions. Today, these institutions regard me as a pinnacle in their legacy of outstanding alums. Such recognition didn't merely stem from my years of rigorous academic training in mathematics, physics, and computer science. Instead,

it was my ability to transcend conventional thinking and solve the Grand Challenge problem of supercomputing that set me apart. My polymathic approach was pivotal in addressing complexities that eluded many of my contemporaries. And I've always been enthusiastic about sharing these insights through diverse platforms, ensuring that the knowledge isn't just confined to academic journals but reaches curious minds worldwide.

Episode 231103-4-philip-emeagwali

1ST LECTURE: THE DAYS OF MY FASTEST COMPUTING

Broadcast 19 August 2021

https://youtu.be/aCbuM1t069s

MATHEMATICS MEETS TECHNOLOGY

Using the Billion Slowest Processors to Solve the Most Complex Problems

My contribution to the world's fastest computing and to mathematical knowledge made it possible to invent faster computers. And create new mathematics. In 1989, I was in the news for discovering how to harness the world's slowest processors. And use those processors to solve the most complex problems at the crossroads where new mathematics, new physics, and the world's fastest computing intersect.

In algebra, the most difficult problem was to discover how to solve the largest system of equations arising when executing detailed computational fluid dynamics codes, such as global climate modeling or petroleum reservoir simulation.

And executing those codes across the millions of processors that outline and define a supercomputer. In the 1970s and '80s, my mathematical quest was to become the first who could solve such initial boundary value problems. And solve them across the slowest processors in the world.

At 8:15 on the morning of July 4, 1989, I discovered that the world's fastest computer can be built with the world's slowest processors. And I invented the supercomputer technology and did so across the slowest processors in the world. That new supercomputer paved the way and became the precursor of the world's fastest computer, which now computes with millions of ordinary processors.

Parallel supercomputing was my mathematical quest for how I could cross the new frontier of the scientific knowledge of how to solve an unsolved, large-scale system of equations in algebra. My quest was to cross that frontier and conquer today's mathematical challenges. My quest was to solve previously unsolved problems and quickly compute the most compute-intensive problems in large-scale computational fluid dynamics, such as simulating the spread of contagious viruses inside Japan's Tokyo subway where 3.1 billion passengers a year are packed like sardines.

In 1989, it made the news headlines that an African supercomputer genius who worked alone in Los Alamos, New Mexico, USA, had invented how to solve the largest system of equations in algebra. And invented how to solve those systems by parallel supercomputing them, or solving many equations simultaneously. **And solving those equations across a new Internet that's a new global network of 65,536 coupled processors. I visualized my computing machinery as a small copy of the Internet**.

I was the African supercomputer scientist and the computational mathematician who was in the news in 1989. I was in the news for inventing how to solve the largest system of equations during the most important applications of algebra. One such application is in computational fluid dynamics. The poster girl of large-scale computational fluid dynamics is the supercomputer petroleum reservoir simulation that must be used to nail down the exact locations of crude oil and natural gas.

Such extremely fast calculations can only be executed **across** an ensemble of millions of processors that occupies the space of a soccer field. And that simulates an oil-producing field that's up to 7.7 miles (or 12.4 kilometers) deep. An oil field is about the size of Abuja, **Nigeria**. The Agbami Oil Field of Nigeria was discovered in late **1998.** Agbami was Nigeria's second-largest deep-water oil field. Agbami is second to the Bonga Oil Field. Agbami Oil Field is located 4,900 feet (or 1.5 kilometers) away from the coastal shores of the central Niger Delta. It has a peak oil production of 250,000 barrels per day.

Why is the supercomputer important to Nigeria? One in ten supercomputers were bought by the petroleum industry. And Nigeria is an oil-producing nation.

UNLOCKING THE POWER OF SUPERCOMPUTERS

Forecasting Weather and Reservoir Simulation

The most powerful computer in the world costs the budget of a small nation. The fastest computer is the heavyweight champion in petroleum technologies. The supercomputer is used to pinpoint deposits of crude oil and natural gas. The fastest computing is my contribution to modern algebra and to the petroleum industry.

I'm the subject of inventor reports because I invented how to execute the world's fastest calculations. And perform them **across** an ensemble of the slowest processors in the world. And solve the most compute-intensive problems at the crossroads where new mathematics, new physics, and the world's fastest computing intersect. I invented how to solve the most compute-intensive problems. And solve them **across** a new Internet that's a new global network of 65,536 coupled, off-the-shelf processors, **each its own master**, that shared nothing. And that each operated its operating system.

By 1986, I realized that the most difficult problem in petroleum reservoir simulation, namely, the solution of a parabolic system of partial **differential** equations, was at its granite physical and mathematical cores, an effort to forecast the weather. But to forecast it **backwards** in time. This backward technique is called hindcasting. And is used to forecast, or rather to hindcast, the "weather." And hindcast, or re-forecast, up to 7.7 miles (or 12.4 kilometers) below the surface of the Earth. And hindcast it **across** an oil-producing field that's up to twice the size of the state of Anambra, Nigeria.

Because I was both a **geologist** of the late 1970s and a **meteorologist** of the early 1980s, I could translate that compute-intensive problem. And translate it **across** physics, calculus, algebra, and computer science. And translate it from the primitive equations of meteorology to the nine **Philip Emeagwali** equations of mathematical geophysics.

This new field of study is described as the subsurface porous media multiphase fluid flow modeling executed **across** millions of off-the-shelf processors that were identical and coupled. In 1989, I could solve the most difficult problem arising in supercomputing. I solved it by deeply understanding and drawing on the mathematical metaphors between the extreme-scaled computational fluid dynamics problems in both meteorology and geology.
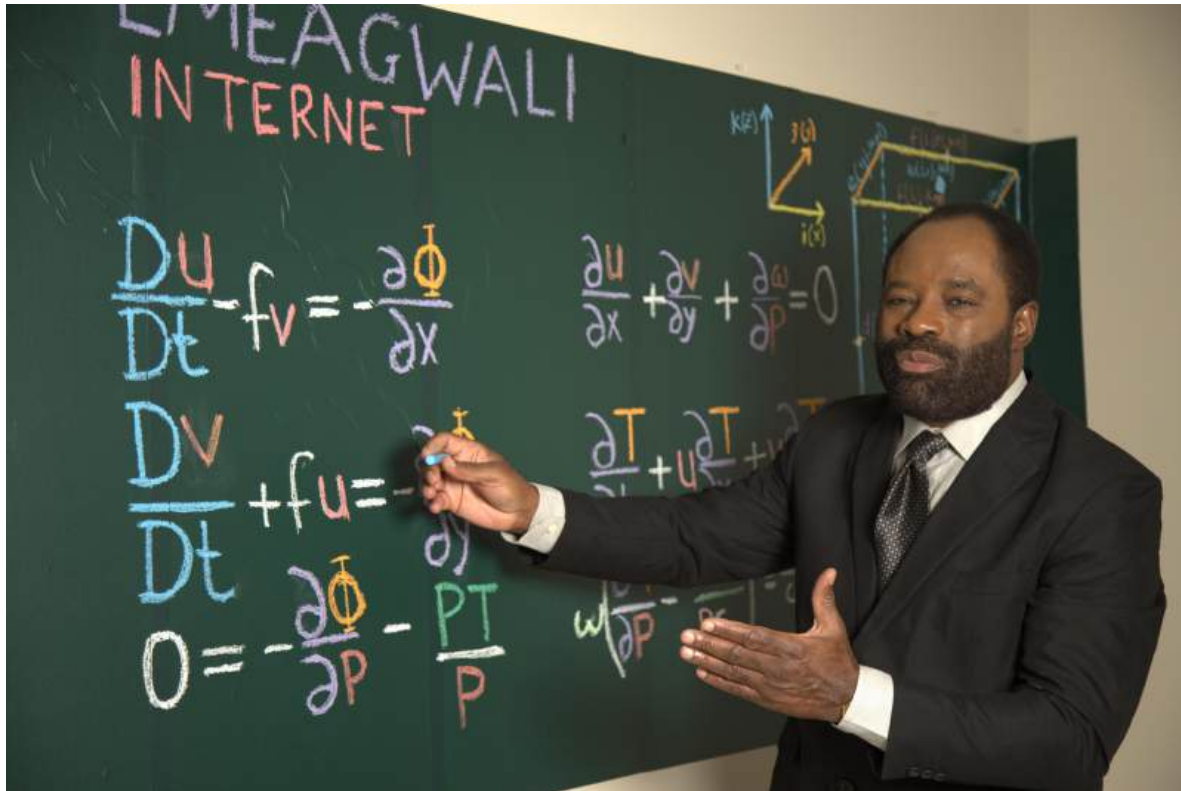
Philip Emeagwali explains his contributions to mathematics, namely, his invention of solving Grand Challenge problems governed by partial differential equations. The photo was taken in October 2022 in New York.

Breaking the Speed Barrier: Crafting the Fastest Computers for Mathematicians

My contributions to mathematics had their calculus and algebra roots in how I reformulated the hardest problem in subsurface geology. I reformulated that mathematical problem and did so in a meteorological context. Furthermore, I parallel-processed that mathematical problem. And I did so across a then world-record ensemble of 65,536 processors. Not only that, I visualized those processors as outlining and defining a small Internet. And as tightly circumscribing a globe and encircling that globe in the manner computers encircle the Earth.

Shattering Expectations by Changing How Mathematicians Solve Tough Problems

300

My 1989 discovery changed how mathematicians solve their most compute-intensive problems. In my new way, the most complex problems in physics, mathematics, and computer science are solved **across** an ensemble of millions of processors, instead of within one processor as was done in the old way.

The toughest problems in mathematics are solved on supercomputers purchased for the Nigerian petroleum industry. The prototypical most difficult problem in supercomputing was to compute at the fastest speeds the motions of crude oil, injected water, and natural gas that were flowing **across** an oil-producing field that's up to 7.7 miles (or 12.4 kilometers) deep.

An oil field is about the size of my hometown of Onitsha, **Nigeria**. The Bonga Oil Field is located off the Nigerian coast and 75 miles [or 121 kilometers] southwest of the Niger Delta. The Bonga Oil Field was underneath an average water depth of 3,300 feet [or one kilometer] and covers 60 square kilometers. And produces both crude oil and natural gas. The Bonga Oil Field began production in November 2005. And was projected to be abandoned in **2022**.

In the **1950**s, **60**s, and **70**s, mathematical physics textbooks classified the governing system of coupled, nonlinear, time-dependent, three-dimensional, and state-of-the-art partial *__differential__* equations as parabolic. Often, when parabolic partial *__differential__* equations are discretized to yield a system of partial *__difference__* equations, the resulting system of equations of computational linear algebra is tridiagonal. Its associated tridiagonal matrix has nonzero elements on the main diagonal and on the two diagonals below and above the main diagonal.

STABILITY OF IMPLICIT APPROXIMATION

$$\begin{bmatrix} 2(1+\gamma) & -\gamma & & & \\ -\gamma & 2(1+\gamma) & -\gamma & & \\ & \cdot & \cdot & \cdot & \\ & & \cdot & \cdot & \cdot \\ & & & -\gamma & 2(1+\gamma) \end{bmatrix} \begin{bmatrix} u_1^{n+1} \\ u_2^{n+1} \\ \vdots \\ u_{N-1}^{n+1} \end{bmatrix} =$$

$$\begin{bmatrix} 2(1-\gamma) & \gamma & & & \\ \gamma & 2(1-\gamma) & \gamma & & \\ & \cdot & \cdot & \cdot & \\ & & \cdot & \cdot & \cdot \\ & & & \gamma & 2(1-\gamma) \end{bmatrix} \begin{bmatrix} u_1^{n} \\ u_2^{n} \\ \vdots \\ u_{N-1}^{n} \end{bmatrix}$$

Reduces to

$$\left(2\tilde{\tilde{I}} - \gamma\tilde{\tilde{B}}\right)\tilde{u}^{n+1} = \left(2\tilde{\tilde{I}} + \gamma\tilde{\tilde{B}}\right)\tilde{u}^n$$

where

$\tilde{\tilde{B}}$ is tri diagonal matrix with "-2" on diagonals and "1" at other entries.

$\gamma > 0 \Rightarrow |2\tilde{\tilde{I}} - \gamma\tilde{\tilde{B}}| \neq 0, \Rightarrow \left(2\tilde{\tilde{I}} - \gamma\tilde{\tilde{B}}\right)$ is nonsingular. $\therefore$ inverse $\exists$

$$u^{n+1} = \left(2\tilde{\tilde{I}} - \gamma\tilde{\tilde{B}}\right)^{-1}\left(2\tilde{\tilde{I}} + \gamma\tilde{\tilde{B}}\right)\tilde{u}^n$$

$$u^{n+1} = \tilde{\tilde{A}}\,\tilde{u}^n$$

$$\tilde{\tilde{A}} = \left(2\tilde{\tilde{I}} - \gamma\tilde{\tilde{B}}\right)^{-1}\left(2\tilde{\tilde{I}} + \gamma\tilde{\tilde{B}}\right) = f(\tilde{\tilde{B}})$$

Eigen values of $\tilde{\tilde{B}}$:

$$-4 \sin^2 \frac{K\pi}{2N}, \quad K = 1, 2, \ldots\ldots N-1$$

Eigen vectors of $\tilde{\tilde{B}}$:

$$\tilde{v}_K = \left(\sin \frac{K\pi}{N}, \sin \frac{2K\pi}{N}, \ldots\ldots, \sin \frac{(N-1)K\pi}{N}\right)$$

Philip Emeagwali's notebook on the stability of implicit finite difference discretizations. (Archives of Philip Emeagwali, College Park, Maryland, 1982)

Why was my contribution to mathematics in the news in 1989? My contribution to mathematics **was this**: In the **1980**s, I changed how we looked at the calculus and the algebra behind the compute-intensive simulations of the motions of crude oil and natural gas that were buried up to 7.7 miles (or 12.4 kilometers) deep. And buried **across** an oil field that's about the size of a town.

My mathematical discovery was that the world's fastest computer can be built with the world's slowest processors. My invention was the cover story of top mathematics publications, including the May **1990** issue of the *SIAM News*, the flagship publication of the Society for Industrial and Applied Mathematics.

New Way of Thinking: Solving the Unsolvable in Algebra

I'm the subject of school essays on famous mathematicians because I changed how mathematicians solve their most compute-intensive problems in algebra. My contribution to the mathematical knowledge and supercomputer technology used to nail down the exact locations of crude oil and natural gas **is this**: I **paradigm shifted** from a parabolic system to a hyperbolic system of partial differential equations that govern that initial-boundary value problem.

I **paradigm-shifted** again from the **tridiagonal** to **diagonal** system of equations of computational linear algebra from the parabolic and hyperbolic systems, respectively. I invented the system of equations of computational linear algebra that must be used to **recover** otherwise **unrecoverable** crude oil and natural gas.

In 20th-century algebra, such systems were most often **tridiagonal**. Such **tridiagonal** systems are unsolvable in parallel. Or impossible to solve by dividing each into a million, or even a billion, lesser compute-intensive problems that can be mapped onto as many processors and then solved with a **one-to-one** correspondence. And solved simultaneously, or in parallel.

Because I was computing and communicating **across** a global network of 65,536 processors, I saw computational mathematics **differently**. Because I saw mathematics **differently**, I thought **differently** and invented my nine partial differential equations **differently**, as hyperbolic instead of parabolic.

BREAKING THE BARRIERS TO MATHEMATICS

The Nine Philip Emeagwali Equations

Why did I invent the nine Philip **Emeagwali** equations? My original derivations of the nine **Emeagwali** equations are lengthy. However, they're fully described in my YouTube channel, named "**Emeagwali**." In essence, my point of departure from the mathematical derivations of Darcy's equations that govern subsurface geophysical fluid dynamics was that I accounted for both the temporal and convective inertial forces. I've posted the mathematical details **across** my one thousand videos that I've also posted on YouTube. For clarity, I detailed my mathematical derivations in close-captioned prose.

My mathematical quest was to discover how to solve the **differential** initial-boundary value problem, not how to solve the **algebraic** discrete problem from that initial-boundary value problem. My quest wasn't **for** how to solve the initial-boundary value problem and **solve it** as an applied mathematician who **solved it** on his blackboard. That quest for an extremely fast computer was for how to solve the never-before-solved largest-scaled problems in computational linear algebra. And solve them as a modern computational mathematician who is sitting astride his global network of sixty-four binary thousand motherboards. Each motherboard was a computational metaphor for his as many, or 65,536, blackboards.

I invented a system of nine partial **differential** equations of calculus. And then invented my nine partial **difference** algorithms or the complete step-by-step instructions each of my 65,536 processors must execute as the condition to solving the difficult mathematical problem. And solving it at the world's fastest speed which made the news in 1989.

I used my new algorithms to **discretize** my system of partial **differential** equations which, in turn, yielded my system of 24 million equations of computational linear algebra. Those were the longest equations in the mathematics of 1989. With my new algorithms, those equations became **diagonal**, instead of **tridiagonal**. It's impossible for my new system of 24 million diagonal equations of algebra and the old system of 24 million tridiagonal equations of algebra to be mathematically equivalent.

Unveiling Identical Math Problems: Cloning Solutions

I visualized my problem as identical twin problems of algebra. The diagonal and the tridiagonal systems of equations of computational linear algebra arose from different initial-boundary value problems with **the same**

boundary condition, **the same** initial condition, and **the same** mathematical and physical domains. However, each initial-boundary value problem had a **different** governing system of partial **differential** equations at the frontier of calculus.

The diagonal and the tridiagonal systems of equations of computational linear algebra are equivalent in their physical essences. They're equivalent in the physical sense that both arose from a **hyperbolic** and a **parabolic** system of coupled, nonlinear, time-dependent, three-dimensional, and state-of-the-art partial **differential** equations, respectively. Both systems of partial **differential** equations of calculus encoded the same set of laws of physics.

My new diagonal and the old tridiagonal systems of equations of computational linear algebra approximated the same difficult mathematical problem of extreme-scale computational physics. My new diagonal and the old tridiagonal systems of equations of computational linear algebra are as different as identical twins from the same **egg** and **sperm** and from the same **genetic materials**.

Just as identical twins are clones, my new diagonal and the old tridiagonal systems of equations of computational linear algebra were clones. They're **not** algebraically equivalent. But they arose from the same difficult mathematical problem of extreme-scale computational physics. Metaphorically speaking, they arose from the same **egg** and **sperm**. Scientifically speaking, they arose from the same set of laws of physics.
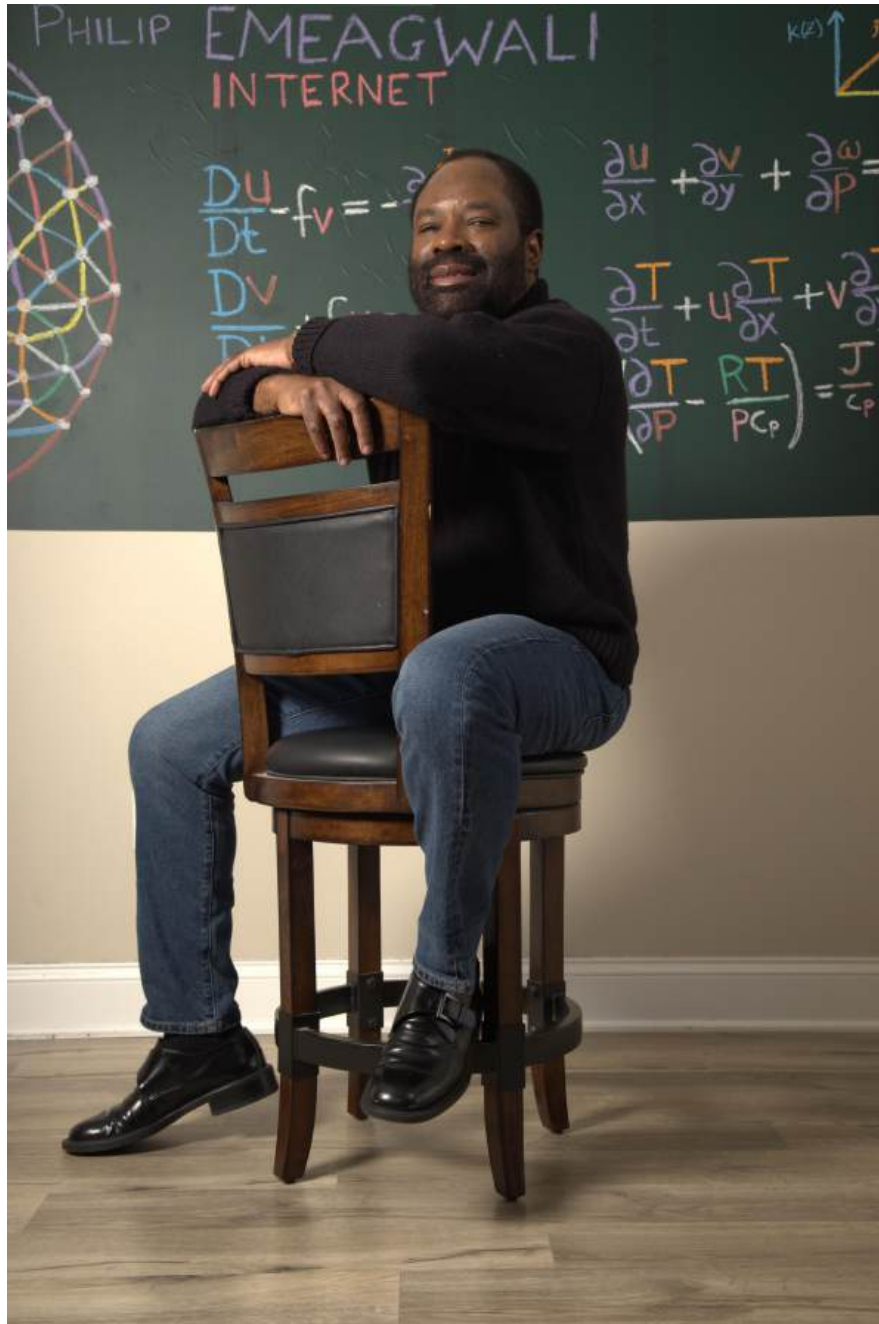
Philip Emeagwali at the chalkboard scribbled with partial differential equations governing fluid dynamical flows.

Math Magician's Unexpected World Record

My contribution to mathematics is this: I solved one of the most compute-intensive mathematics problems. And I solved it at the fastest computer speed executed across an ensemble of the slowest processors in the world.

306

My **invention** of fastest computing, which occurred on the Fourth of July **1989**, changed how mathematicians solve the most compute-intensive problems in algebra. The cover stories of mathematics news journals read by leading mathematicians celebrated my mathematical discovery as a breakthrough that makes it possible for high-performance computational mathematicians to achieve speeds in supercomputing previously considered impossible.

In 1989, mathematicians celebrated my discovering the fastest computing. And did so because it heralded the end of their old arithmetic paradigm of solving one compute-intensive problem **at a time.**

And it marked the beginning of the new paradigm of **concurrently** solving millions of sets of compute-intensive problems—and solving them simultaneously**.** On the Fourth of July **1989**, I achieved a supercomputer breakthrough. I used the 65,536 slowest processors in the world to reduce 65,536 days or 180 years of **time-to-solution** to merely one day.

Furthermore, I discovered that the most compute-intensive problems in algebra **which**, in turn, **arose** from calculus could be solved **across** a new Internet. Not only that, but I invented that new Internet as a new global network of sixty-four binary thousand coupled processors. Each processor had its dedicated memory that shared nothing, but were in dialogue with each other.

My high-performance computing experiment which I conducted **across** a new Internet that's a new global network of 65,536 processors led to my discovery that elucidated why the world's fastest computer must be powered by millions of processors.

My discovering how to execute the world's fastest computing was mentioned in the June 20, 1990, issue of *The Wall Street Journal* because it opened the door to the fastest supercomputers which were powered by over ten million interconnected yet autonomous processors.

Reshaping the Oil and Gas Landscape with Supercomputing

I discovered how the oil and gas industry now harness the fastest computing from the slowest processors. And do so to nail down the locations of subterranean hydrocarbons. My discovery that millions of processors can be used to solve the most compute-intensive problems is the new knowledge used throughout the petroleum industry. It's the most critical technology now used to pinpoint deposits of crude oil and natural gas and used to recover them. It's used from the producing oil fields of Nigeria to the oil fields of Angola.

I used the largest system of equations of algebra that defined the most compute-intensive problems in physics as the backdrop for my experiments

across my ensemble of 65,536 processors. I used those equations as my supercomputer testbeds. In the **1970**s and **80**s, the fastest computing **across** the slowest processors existed only in science fiction.

My contribution to computer science was that I challenged the established truth and turned that science fiction to reality. That truth was the widely held belief that the slowest processors in the world cannot compute together. And do so to solve the most compute-intensive problems in algebra and in extreme-scale computational physics. And solve them at the fastest recorded supercomputer speeds.

The recognitions which I received from the supercomputing community, in 198**9** and later, was the first time such **skepticism** over parallel supercomputing was overcome. In the **1970**s and **80**s, 25,000 supercomputer scientists tried to parallel process and do so **across** processors and computers. They gave up. They dismissed my attempts to solve the most complex problems—via parallel processing—as **impossible**. I proved them wrong.

THE COMPUTING "SPEED BARRIER" SHATTERED

Parallel Processing Unites the Fastest and Slowest Computers

In an often-cited paper published between April 18 and 20, **1967**, the IBM supercomputer designer **Gene Amdahl** formulated **Amdahl's law**. Briefly, **Amdahl's law** predicted that supercomputing **across** the slowest processors will forever remain an enormous waste of everybody's time. **Seymour Cray** designed seven in ten supercomputers sold in the 1970s and 80s. **Seymour Cray** agreed with **Gene Amdahl**.

Using the chicken as his metaphor for the slowest processor and the ox for the fastest processor, **Seymour Cray** asked the supercomputing community his famous question: "If you were plowing a field, which would you rather use? Two strong oxen or 1024 chickens?"

Regarding the ox versus a billion-chicken debate, I visualized the Grand Challenges of supercomputing as breakable and chopped up into one billion less-challenging problems, each akin to a few weed seeds in a large field. My theory was that a billion hungry chickens can eat up a thousand billion weed seeds and eat them faster than one hungry ox.

Parallel computing is a century-old theory that exists in science fiction. My contribution to computer science made the news because my invention of the first supercomputing **across** the world's slowest **computers** turned that science fiction into reality.

On the Fourth of July 1989, the century-old theory—of harnessing 64,000 human computers—became timeless and new again. It was never old. I came of age in the 1970s when the *Computer World* was the mouthpiece of the information technology industry. A state-of-the-art survey published in the June 14, 1976, issue of the *Computer World*, quoted the leaders of thought in the supercomputers as unanimously agreeing that harnessing thousands of processors will be too "large and clumsy."

The title of that *Computer World* article summed up the **skepticism** towards parallel processing and my later discovery of the world's fastest computing **across** the world's slowest processors. The **pessimism** was embedded into the title of that article: "Research in Parallel Processing Questioned as 'Waste of Time.'"
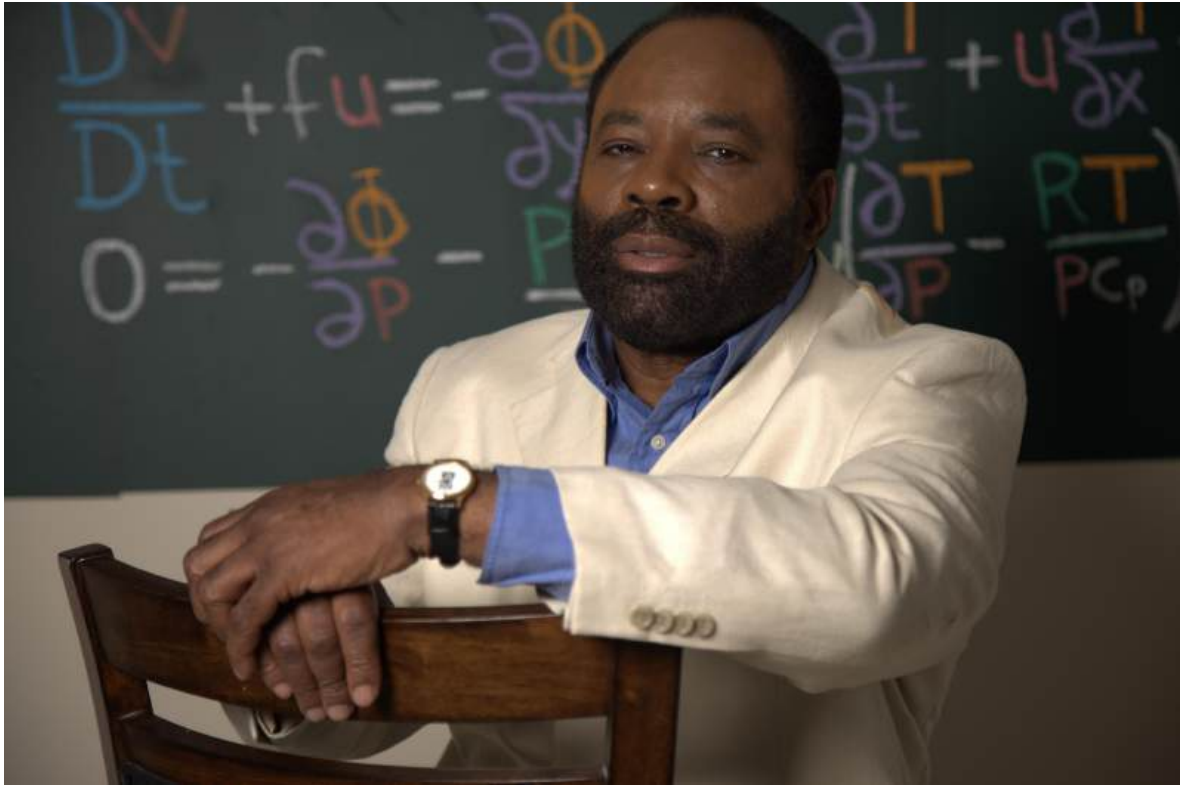
Philip Emeagwali at the chalkboard scribbled with partial differential equations governing fluid dynamical flows.

BEYOND THE BINARY

A Billion Times Faster: Computing with the Slowest Processors and Changing the Way We Look at Computers

 My discovery made the news because it was computing's equivalent of breaking the sound barrier to create a sonic boom. Before my discovery, the fastest computing across the slowest processors was an intellectual barrier that no human dared to cross. I was in the news because I was the first to cross that intellectual barrier. I was the first to scale the pinnacle known as the world's fastest computing.

On July 4, 1989, I became the first to plant his country's flag in the then-unknown territory of the supercomputer, as it's known today and as it's expected to be known tomorrow. I used 65,536 coupled processors to demonstrate how a mammoth supercomputer can be built from a billion processors. I discovered how harnessing up to a billion processors will enable the world's fastest computer to have the horsepower it will need to solve the grand challenges of the scientific world.

I researched as a lone wolf because my supercomputing milestone was believed to be unachievable. Parallel processing powers every supercomputer manufactured today. The supercomputer is to science what the microscope is to biology.

My scientific discovery, which occurred on July 4, **1989,** was that the world's slowest processors can be used to solve the most compute-intensive problems in science, engineering, and medicine. My discovering the central essence of the world's fastest computers made the news headlines because it changed how we look at the modern computer. I discovered how to reduce 180 years of **time-to-solution** of the most complex problems in large-scale algebra and computational fluid dynamics to one day of **time-to-solution.**

 Philip Emeagwali returning from the soccer field and with his son, Ijeoma, at 1781 Cram Circle, Ann Arbor, Michigan, early Summer 1991.

In the 19**70**s and **80**s, I was mocked and ridiculed by vector supercomputer scientists and offhandedly dismissed because I claimed to have discovered how to reduce the **times-to-solution** of the most compute-intensive problems—such as the high-stake global climate models— and reduce them by a factor of one billion **across** a new Internet that's a new global network of one billion processors, **each its own master**, that shared

nothing. I was mocked for claiming my discovering the world's fastest computing and claiming it when it was considered impossible to reduce those **times-to-solution** and do so by a factor of eight.

When confronted with such a compute-intensive problem, the vector supercomputing community joined ranks and tore holes in my then unsubstantiated theory. I theorized that the slowest processors could be harnessed and used to compute faster than the fastest supercomputer. My unorthodox approach to solving compute-intensive problems is called parallel supercomputing. Until my experiment of July 4, 1989, the parallel computer was not a supercomputer. It was then a million times slower than the supercomputer.

In 1989 and in [the University of Michigan] Ann Arbor, Michigan, my character was maligned because I was conducting research on parallel supercomputers, a technology then dismissed as pseudoscience. I distributed six copies of my 1,057-page supercomputer report to scientists in [University of Michigan] Ann Arbor, Michigan. All six copies were thrown into the wastebasket.

To their surprise, a few weeks later, it made the news headlines that I had won the equivalent of the Nobel Prize of supercomputing. I won that prestigious prize for my supercomputer invention which I fully described in my 1,057-page research report that they trashed into the wastebaskets of [the University of Michigan] Ann Arbor, Michigan.

After I won that award in 1989, the intellectual fireworks exploded. I didn't kill any person. Yet, I was subjected to a Galileo trial that was computing equivalent to the O.J. Simpson trial. I am the modern-day Galileo.

If they were to accept my discovery, they must forget many things they've learned, such as their belief in white intellectual supremacy. I solved the most difficult problem at the crossroads where new mathematics, new physics, and the world's fastest computing intersected. That accomplishment was the reason I was compared to the likes of Albert Einstein, Pythagoras, and Euclid.

In retrospect and for racial and intellectual reasons, I was not taken seriously as a Black mathematician who was equally at home in physics and computer science. I was confident because, as far as I knew, I was the only person in the world who devoted almost the entire decades of the 1970s and 80s to supercomputing across processors. I acquired the specific sets of skills and knowledge within mathematics, physics, and computer science that, in turn, would have enabled me to solve the most difficult problems in supercomputing.

First, I was Black and African and, therefore, grossly underrated with respect to Albert Einstein. **Second**, I was alone and unsalaried supercomputer scientist whose research was grossly undervalued by both the funding agencies and the prize committees. They automatically rejected any submission from a Black African scientist. **Third**, I was misperceived as only a one-dimensional mathematician or physicist, never as a three-dimensional polymath, or a triple threat that was also at the edge of understanding in computer science. **Fourth**, it was not widely known that I had been continuously supercomputing, since June 20, 1974, on one of the world's fastest computers
that was at 1800 SW Campus Way, Corvallis, Oregon. **Fifth**, I was also trained as an astronomer, meteorologist, and geologist.

Philip Emeagwali, near the Computer Center, 1800 SW Campus Way, Corvallis, Oregon, where I began supercomputing on June 20, 1974. Photo taken in late July 1975.

Therefore, I was not timid about **crossing** disciplinary boundaries and doing so when pursuing the elusive answer to the biggest question in

314

supercomputing. That question **was this**: How do we compute fastest with the slowest processors?

In supercomputing, the most compute-intensive problem must be breakable into a billion pieces that can be solved simultaneously**.** And solved across a billion processors that each was self-contained and shared nothing. Solving the most difficult problem across the world's fastest computer is akin to putting a jigsaw puzzle, with a billion pieces, together.

UNTHINKABLE WORLD'S FASTEST COMPUTING

My invention of how to compute in parallel—or compute many things simultaneously—was mentioned in the June 20, 1990, issue of The Wall Street Journal. It took me the past sixteen years to discover how and why computing across the slowest processors makes the fastest computers fastest. My discovery opened the door that elevated the parallel computer to a new supercomputer that's up to a billion-fold faster, and that's used to solve the largest system of equations in many fields. Such Grand Challenge problems range from computational fluid dynamics to computational medicine, such as simulating the spread of contagious viruses across the Onitsha market where social distancing rules are not enforced.

In the 1980s, there were 25,000 computational mathematicians who also desired to know how and why many processors makes the slowest computers faster and makes the world's fastest computer the fastest. The reason those mathematicians gave up on massively parallel processing was because their textbook authors warned them that supercomputing with up to a billion processors will forever remain an enormous waste of everybody's time.

If any of those mathematicians, physicists, or computer scientists had the knowledge that I had, they would have been famous for solving the most difficult problem in supercomputing that I solved in 1989, and that made the news headlines.

Unveiling the Secrets of Computing and Rewriting the Rules

Because everybody **ridiculed** and **rejected** the theory of solving many problems simultaneously, parallel supercomputing was **abandoned.** That was how I became the lone full-time programmer of sixteen of the most massively parallel supercomputers ever built.

Today, the most powerful supercomputer hosts up to ten thousand programmers. What differentiates me and the other 25,000 vector supercomputer programmers of the **1980**s **were these**: I **invented** how to harness an ensemble of 65,536 off-the-shelf processors, **each its own master**, that were coupled and that shared nothing.

In **1989**, it made the news headlines that **an African supercomputer genius in the USA** had invented how to harness 65,536 processors. And invented how to use them to solve the most compute-intensive problems, called Grand Challenges of 21st century mathematical physics. Such problems arise while addressing some of the world's biggest problems, such as simulating the spread of COVID-19.

My invention opened the door to the technique of **parallel** and **distributed** algorithms and the companion technology of the **massively parallel** supercomputer. Parallel computing is the core knowledge that makes the **impossible**-to-solve **possible**-to-solve. And makes it possible to solve up to a billion mathematical problems simultaneously. I was that African supercomputer scientist in the news in 198**9**.

Solving Tough Math on the Slowest Computers: Achieving the Impossible!

The grand challenge of computing was to be the first to solve the most difficult problem. And solve them at the world's fastest speeds to expand the frontiers of human knowledge about the world and humanity. But solve them **across** the world's slowest processors. A reason it was called a Grand Challenge problem was that the 25,000 vector supercomputer scientists of the **1980**s and earlier couldn't solve it. The reason vector supercomputer scientists couldn't **experimentally invent** the fastest computing **across** the slowest processors was that they were merely reading about how it's impossible to harness 65,536 processors.

In the **1980**s, it was believed that it will forever remain impossible to harness millions of processors. And use them to cooperatively solve the most compute-intensive problems at the frontiers of knowledge in science, engineering, and medicine. Those 25,000 naysayers had the opportunity I had to solve the most compute-intensive problems that were central to supercomputing.

All they needed was the education and knowledge. Each of those 25,000 vector supercomputer scientists knew that the **invention** of supercomputing **across** the slowest processors would be akin to discovering a **gold mine**. My contribution to the speed of the supercomputer is the reason I'm the subject of school essays on "Inventors and their Inventions."

317

Twelve-year-olds often ask for pictures of my son (Ijeoma), my mother (Iyanma Agatha Emeagwali), and Philip Emeagwali. Photo taken in Monkton, Maryland, USA, (October 30, 2006)

2ND LECTURE: THE CODE WARRIOR

Philip Emeagwali and the Connection Machine, Cambridge, Massachusetts, November 30, 1990. In the 1980s, Emeagwali was the only full-time programmer of a dozen massively parallel supercomputers.

Broadcast 19 August 2021

https://youtu.be/GcV14ZCdM5w

THE FIRST SUPERCOMPUTER

 In 1989, I was in the news because I contributed the world's fastest computing to mathematical knowledge. That contribution changed how mathematicians solve some of their most difficult problems. In their old way, the solution of the most difficult problem in computational mathematics was unsuccessfully tackled on the blackboard or one processor. In my new way, such problems are solved across up to a billion processors.

On July 4, 1989, I became the first to cross the boundary of human knowledge of the world's fastest computing across the world's slowest processors. Those processors encircled a hyper-globe in the sixteenth-dimensional hyperspace and did so in the manner the Internet encircles planet Earth. That was how I invented the first Internet which is a global network of 65,536 processors.

What is Philip Emeagwali known for? I discovered how to combine computers into a supercomputer that's an Internet. That discovery is like a light from an ancient sky. I'm the only father of the Internet that invented an Internet.

The supercomputer of today is radically different from those of the 1980s and earlier. Back then, supercomputers were powered by only one processor. Each was the size of a refrigerator. And it costs up to forty million dollars each. The world's fastest computer today can be powered by up to one billion processors. It occupies the footprint of a football field. And they cost forty percent more than the mile-long Second Niger Bridge in Nigeria.

I invented the world's fastest computing, as we know it today. In **1989**, I was in the news for discovering that the slowest processors could be used to solve the biggest problems and find their answers at the fastest speeds. The fastest computer is why you know the weather before going outside.

Computing the Unimaginable-to-Compute: How Coronavirus Spreads

I was in the news for my contributions to the fastest computing because I discovered that some compute-intensive problems that were impossible to solve with one processor could be solved across an ensemble of up to a billion processors. That's how the supercomputer is used to track how the coronavirus disease spreads. That was the audacity of my world's fastest computing, which occurred on July 4, 1989, and that made the news headlines.

320

The inspiration that led to my scientific discovery of how and why using a thousand processors makes the new supercomputer the **fastest** came from my mathematical investigations of the rates of **error growths** that occur while solving the largest systems of equations in algebra.

Error growths occur while executing the most compute-intensive set of floating-point operations of arithmetic. Floating-point operations **arose from** finite difference equations of computational linear algebra. Finite difference approximations **arose from** discrete approximations of partial **differential** equations that govern initial-boundary value problems arising at the frontier of calculus.

My inspiration to compute at the fastest recorded speeds **arose from** the need to execute the most compute-intensive mathematical operations. Such operations **arose from** the need to solve the largest system of equations of algebra. Such large-scale algebra **arose from** the need to discretize partial **differential** equation at the frontier of calculus. Such abstract calculus **arose from** the need to encode some laws of physics and chemistry that govern the twenty most difficult problems in supercomputing.

The poster child of the most difficult problems in supercomputing is the extreme-scaled computational fluid dynamics codes that must be used to simulate the spread of a once-in-a-century global pandemic. The supercomputer must be used to simulate the spread of virus droplets **among** the billions upon billions of train passengers worldwide that are packed like sardines.

The fastest computer is used to simulate ways of stopping the spread of contagious viruses and solve unsolved problems that are important to society.

Achieving Optimal Performance: Guaranteeing Convergence, Consistency, and Stability of My Algorithms

I began supercomputing on June 20, 1974, in Corvallis, Oregon. At that time, I described myself as a mathematician who is a number theorist. My high-performance computing started as a hobby, not a serious profession.

In late 1970, at 88 Venn Road, Onitsha, I conducted independent research on "Pythagorean triplets." Each triplet was an integer solution of the equation A-squared plus B-squared equals C-squared. In the 1970s, I gradually shifted my research interest from number theory of pure mathematics to numerical analysis of applied mathematics to large-scale computational fluid dynamics.

Philip Emeagwali (in dark shirt and second from right of last row with five students) in a photo call at Saint Charles House of Christ the King College, Onitsha, Nigeria, where he was only known by his nickname "Calculus." Bishop Francis Arinze lived in the rear building, early 1971.

And, finally, to massively parallel supercomputing that's executed **across** up to a billion processors. I visualized my 65,536 processors as encircling a hypersphere in a sixteen-dimensional hyperspace. And encircling it in the manner the Internet encircles the Earth.

The mathematical fields of **number theory** and **numerical analysis** are almost diametrically opposite. Number theory is abstract and is investigated on the blackboard. On the other hand, numerical analysis is applied and investigated on the motherboard. Number theory demands precise solutions. And is used to invent encryption algorithms. In contrast, numerical analysis accepts approximate solutions of partial **difference** algorithms arising in computational physics.

Since the equivalence theorem was discovered, in 1954, research computational mathematicians investigating the discrete solutions of partial **differential** equations, indirectly, proved convergence. And did so by only proving consistency and stability.

322

By convergence, I mean that as my grid spacing tends to zero my solution of my system of partial difference equations converges to the exact solution of my system of partial differential equations that I discretized.

In 1981 and a few years after, and in College Park, Maryland, I did extensive consistency and stability analyses. That is, I theoretically and experimentally investigated the rates of propagation of numerical errors that arise when the algebraic computations advance from one time step of finite difference approximations to the next time step. I knew in advance that my approximations to the originating partial differential equations were stable if and only if the errors introduced at any time step were not amplified at later time steps but were reduced at subsequent time steps.

In my stability proofs, I computed the norms of the solution. In theory, the stability of finite difference approximations of real-world partial differential equations are impossible to prove. Instead, I proved the stability of a "close" problem. And then confirmed the stability of the complete partial difference approximations. And do so by coding and testing the numerical solutions.

From my linearized **stability analyses,** I mathematically discovered that I'd do fewer computations if I started from the first principles. Or start from the second law of motion in physics textbooks. And do so to re-derive the governing system of coupled, nonlinear, time-dependent, three-dimensional, and state-of-the-art partial **differential** equations of calculus. Such equations govern the flows of crude oil, injected water, and natural gas that often flow up to 7.7 miles (or 12.4 kilometers) deep and **across** an oil-producing field that's about the size of Baltimore, **Maryland**.

I mathematically discovered that when I include the temporal and the convective inertial forces, then the governing partial **differential** equations become hyperbolic rather than parabolic. From my linearized **stability analyses**, I mathematically discovered that I'd do fewer computations if the discretizations, or reduction from infinite to finite, of the governing system of partial **differential** equations to an approximating system of partial **difference** equations were explicit rather than implicit.

Philip Emeagwali, Bend, Oregon (January-February 1975). He began supercomputing the previous year.

Breaking Through the Restrictions: Exploring the Possibilities Beyond Darcy's and Amdahl's Laws

In 1981, my big question was to figure out how to bypass the two vexing limits in physics and computer science that were known as Darcy's law and Amdahl's law, respectively. From my linearized **stability analyses,** I mathematically discovered how to bypass the constraint that was imposed by Darcy's law. That constraint limited the execution times of computational fluid dynamics codes that were governed by Darcy's law. And bypassed the perceived Amdahl's law limit of the maximum speed increase of a factor of eight.

That was how I addressed the vexing limit of Darcy's law that could make my world's fastest computing less efficient and more compute-intensive. That was how I addressed the vexing limit of Amdahl's law on the speedups **across** the millions of processors powering the world's fastest computer.

From my linearized **stability analyses,** I learned that my **diagonal** system of equations of algebra **arose from** conditionally stable and explicit finite difference algorithms while my **tridiagonal** system of equations of algebra **arose from** unconditionally stable implicit finite difference algorithms. In the practical terms of large-scale, high-performance supercomputing, implicit methods allow larger time steps, which are more efficient. But implicit methods only allow sequential calculations which are slower to compute. I discovered that implicit methods that yield a system of tridiagonal equations of algebra yield longer **times-to-solution** than explicit methods that yield a system of diagonal equations of algebra.

I discovered that it's **possible** to solve the system of diagonal equations of algebra and solve them in parallel, or by solving them simultaneously with 65,536 processors. Or to simultaneously solve the diagonal system and solve them **across** my new Internet.

I invented that new Internet as my new global network of 65,536 processors that were identical and equal distances **apart**. As correctly explained in textbooks on computational linear algebra, it's impossible to directly reformulate a system of **tridiagonal** equations and reformulate that system into an equivalent diagonal system.

That was my motivation for reformulating both systems of diagonal and **tridiagonal** equations. And reformulating them to solve the same initial-boundary value problem, particularly those in large-scale, high-fidelity computational fluid dynamics, such as petroleum reservoir simulations.

Unlocking the Unimaginable: How to Make the Impossible, Computable

In the **1970**s and **80**s, my dream of discovering the world's fastest computing **across** the world's slowest processors was ridiculed as

wonderfully useless. The reason I conducted my world's fastest computing research alone was that supercomputing **across** the slowest processors was mocked and dismissed as a **vacuous gimmick**.

In the 19**70**s and **80**s, the conventional wisdom in supercomputing **was this**: "Solve one problem **at a time** and solve that problem **as** fast **as** possible." In an article dated September 2, **1985,** the president of Cray Research Incorporated, the company that then manufactured seven in ten supercomputers, described his company's attempt to harness 64 processors as "more than we bargained for."

My mathematical quest began as an abstract speculation of a lone mathematician in 1974 in Corvallis, Oregon. That speculation was on the pure logic of differential calculus and in the compute-intensiveness of large-scale algebra.
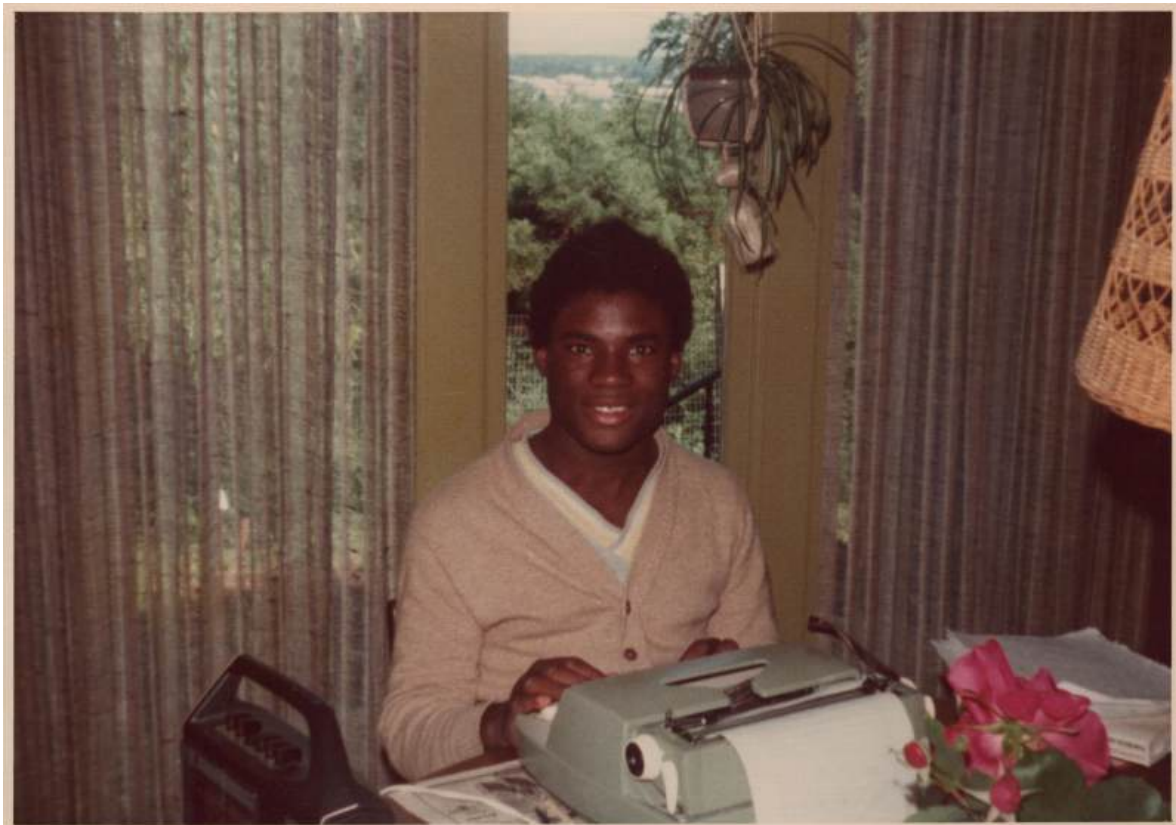
Philip Emeagwali, 15 Edgewood Way, Corvallis, Oregon, early June 1975.

326

REIMAGINING SOLVING PROBLEMS IN TANDEM

 The precondition to discovering my world's fastest computing was that I, first and foremost, also discovered how to efficiently map my codes across up to one billion processors. My quest for the world's fastest computing continued as the rigorous analysis of 65,536 computer codes which were developed with my one-code to one-processor mapping and correspondence. That mapping was to the as many processors that outlined and defined my new Internet that's a new global network of 65,536 processors. I invented how to make the otherwise impossible-to-solve possible-to-solve. Such mathematical problems arise when attempting to solve the largest systems of equations in the computational linear algebra of petroleum reservoir simulation.

I discovered how to solve the most difficult problems arising in mathematical physics. And solve them **across** the millions of processors that outlined the fastest supercomputers. I invented how to solve the most compute-intensive problems in computational fluid dynamics. And how to solve them **across** a new Internet, that is a new global network of 65,536 coupled processors.

I'm the mathematician who invented how to do more computations. And do the most computations in one second on the supercomputer. And do more computations than what every person on planet Earth can compute every second of every day for one year.

Philip Emeagwali's Method for Diagonalizing Tridiagonal Systems

I did the **impossible** by reformulating my system of equations of computational linear algebra that were tridiagonal that couldn't be solved in parallel or solved **across** an ensemble of million processors. And by reformulating that system from the governing second law of motion in physics textbooks and the governing partial **differential** equations, or PDEs, of calculus that encoded that law. And discretizing and solving my system of PDEs as a system of diagonal equations of computational linear algebra that solves an equivalent problem that could now be solved in parallel.

I didn't reformulate my system of equations **directly**. I reformulated them, **indirectly**. My systems of diagonal and tridiagonal equations each arose from the same detailed petroleum reservoir model. To **recover** otherwise **unrecoverable** crude oil and natural gas, we are only required to use the laws of physics to simulate the petroleum reservoir. It didn't require that we solve a specific system of tridiagonal equations of algebra and solve it by

327

or in itself.
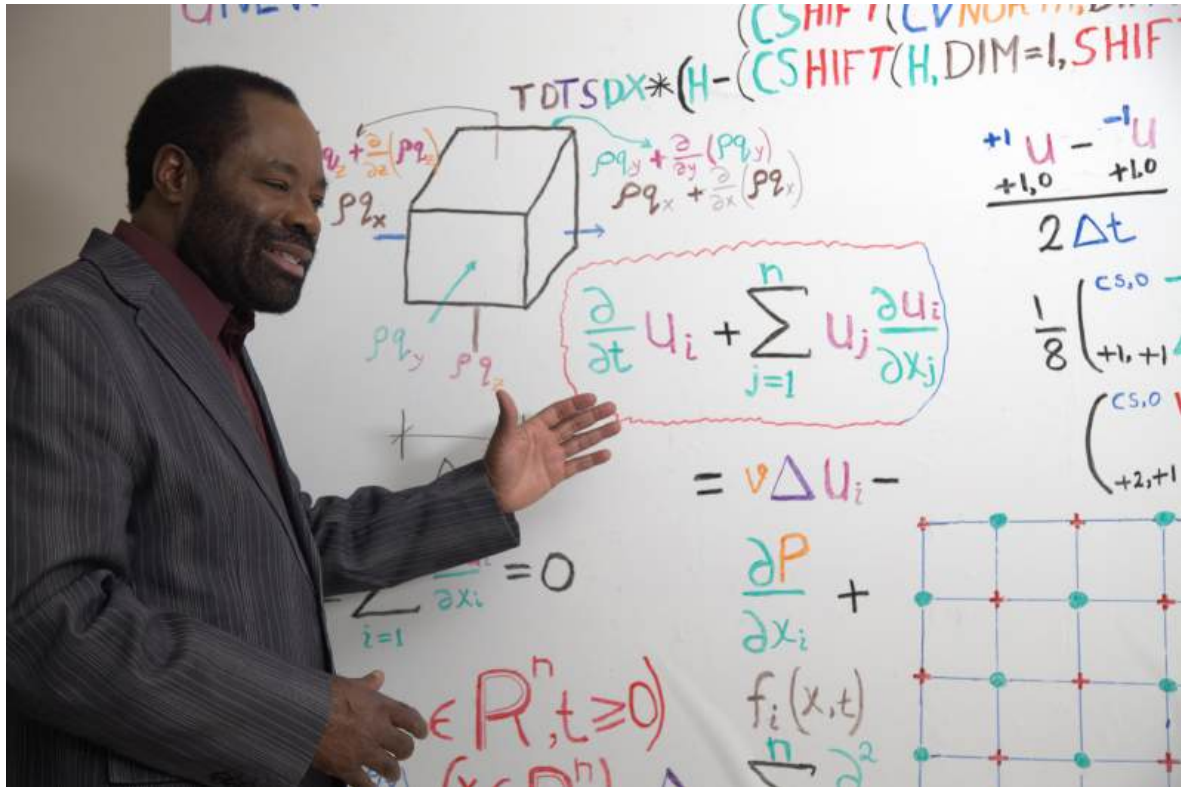
Philip Emeagwali on his whiteboard explaining his contributions to mathematics, New York, October 2022.

UNLOCKING THE SECRETS OF OILFIELDS

With The Philip Emeagwali Equations

The Secrets of Time: My Journey Toward Inventing a New Calculus from Ancient Physics

How did I invent nine new partial differential equations of calculus? And invent them from physics's second law of motion that was discovered three centuries and three decades ago? To make such an invention demanded that I be a polymath at the edge of scientific understanding, not a mathematician alone. The polymath or renaissance person—that's a triple threat in physics, mathematics, and computing—focuses on solving the most difficult problem in computational mathematics and solving it as a holistic whole.

Often, the mathematician is limited to only solving the algebra problem. And the mathematician forgets that mathematics is a tool and a means to the end, not the end itself. That algebra problem was derived from the physics problem.

I discovered a different path to simulating the motions of crude oil, injected water, and natural gas flowing up to 7.7 miles (or 12.4 kilometers) deep. And **across** an oil-producing field that's often the size of Lagos, Nigeria.

I discovered how to simulate the petroleum reservoir. And do so a billion times faster and by returning to **first principles**, which were the set of laws of physics and chemistry governing the motions of the crude oil, natural gas, and injected water flowing across reservoir rocks.

I began from the top and from physics's second law of motion and did so to enable me to correctly re-derive the governing system of nine coupled, nonlinear, time-dependent, three-dimensional, and three-phase partial **differential** equations of calculus.

My new governing system of partial *differential* equations is **hyperbolic** and represents a new paradigm in calculus. The old governing system of partial *differential* equations is **parabolic** and represents an old paradigm in calculus. My new governing system describes the three-dimensional motions of crude oil, injected water, and natural gas flowing **across** a highly anisotropic and heterogeneous oil field. The new system of coupled, nonlinear nine Philip **Emeagwali** equations describes the motions of fluids through an oil-producing field and along three spatial directions.

By 1989, I had discretized those partial differential equations to yield a new system of 24 million diagonal equations, instead of the old system of 24 million tridiagonal equations. Both were the longest systems of equations ever solved in algebra. And that is one of my contributions to how to solve the largest systems of equations of computational linear algebra from petroleum reservoir simulation. And how to solve them across a new Internet that is a global network of processors, **each its own master**, that were coupled and that shared nothing.

BREAKING THE LIMITS OF MATHEMATICS

Supercomputing the Unsolvable: Maximizing Oil Recovery with Alternating Direction Implicit Method

 Since June 20, 1974, in Corvallis, Oregon, my quest for the world's fastest computing was to invent how to solve the most compute-intensive problems in linear algebra. I invented how to solve them across a new Internet. And I invented that new Internet as a new global network of processors that were identical. And that I visualized as equal distances apart. Since the late 1940s, the method of choice among computational mathematicians that tried to solve the most difficult problems in subsurface geophysical fluid dynamics was called the alternating direction implicit method, or the ADI method.

The ADI method was used to discretize a system of coupled, nonlinear, time-dependent, and two- or three-dimensional partial **differential** equations. Such equations were classified as parabolic. They governed the subterranean flows of crude oil, injected water, and natural gas.

In the **1950**s, **60**s, and **70**s, the alternating direction implicit method was widely used to formulate systems of **tridiagonal** equations that arise from finite difference discretizations of the system of partial **differential** equations that governs the subsurface motions of fluids flowing up to 7.7 miles (or 12.4 kilometers) deep below the surface of the Earth.

Unlock the Mysteries of Subterranean Flows with Solving Tridiagonal Equations!

In 198**1**, I discovered that it will be **impossible** to solve, in parallel, a system of **tridiagonal** equations in large-scale algebra. And solve that system by dividing it into up to one billion lesser challenging problems that, in turn, could then be solved with a one-problem to one-processor mapping and correspondence. And solved simultaneously and **across** an ensemble of up to one billion processors.

I discovered that it will be **impossible** to solve a system of **tridiagonal** equations and solve it by **synchronously** emailing equal-sized sub-systems of that system. And emailing my sub-systems **across** my **1,048,576** bidirectional, regular, and short email wires. Likewise, I visualized those email wires as being equal distances **apart**.

Furthermore, I visualized my email wires as marrying my global network of the slowest 65,536 processors in the world. And doing so to emulate one

331

seamless, coherent, and gigantic super-fast processor that's a virtual supercomputer. As the lone programmer of my virtual supercomputer, I visualized those processors as married together as one coherent unit that's not a supercomputer, by itself, but that's a new Internet *de facto.*

I discovered that it will be **impossible** to evenly distribute equal sub-systems of my system of **tridiagonal** equations and distribute those sub-systems **across** each of my 65,536 identical and coupled processors. Each processor operated its operating system and had its dedicated memory.

Eliminating the Middle: I Transformed Tridiagonal Systems into Diagonal Systems for Fast, Simplified Solutions!

Because it's impossible to solve a system of tridiagonal equations and solve it in parallel, I formulated an equivalent system of 24 million **diagonal** equations that approximated a more accurate system of nine new partial **differential** equations which **I invented.**

And that solves the **same** petroleum reservoir problem. Or solves the **same** initial-boundary value problem with different governing partial **differential** equations that differently encoded the **same** laws of physics that's at the physics core of the petroleum reservoir simulator.

My mathematical **beginning** from a system of parabolic partial **differential** equations to **inventing** that system as a more accurate system of hyperbolic partial **differential** equations and my **formulation** of a system of tridiagonal equations that approximated my parabolic partial **differential** equations and my **formulating** of that system as a system of diagonal equations that approximated my hyperbolic partial **differential** equations were **mathematical inventions** in calculus.

That invention, or new mathematics, or my finite difference discretizations of the **nine Philip Emeagwali equations**, changed how we understand or solve the most compute-intensive problems that arise when simulating the flows of crude oil, injected water, and natural gas flowing **across** a highly anisotropic and heterogeneous producing oil field. A typical oil field is located 6,000 feet (or 1.83 kilometers) below the surface of the Earth. But it can be up to 7.7 miles (or 12.4 kilometers) deep.
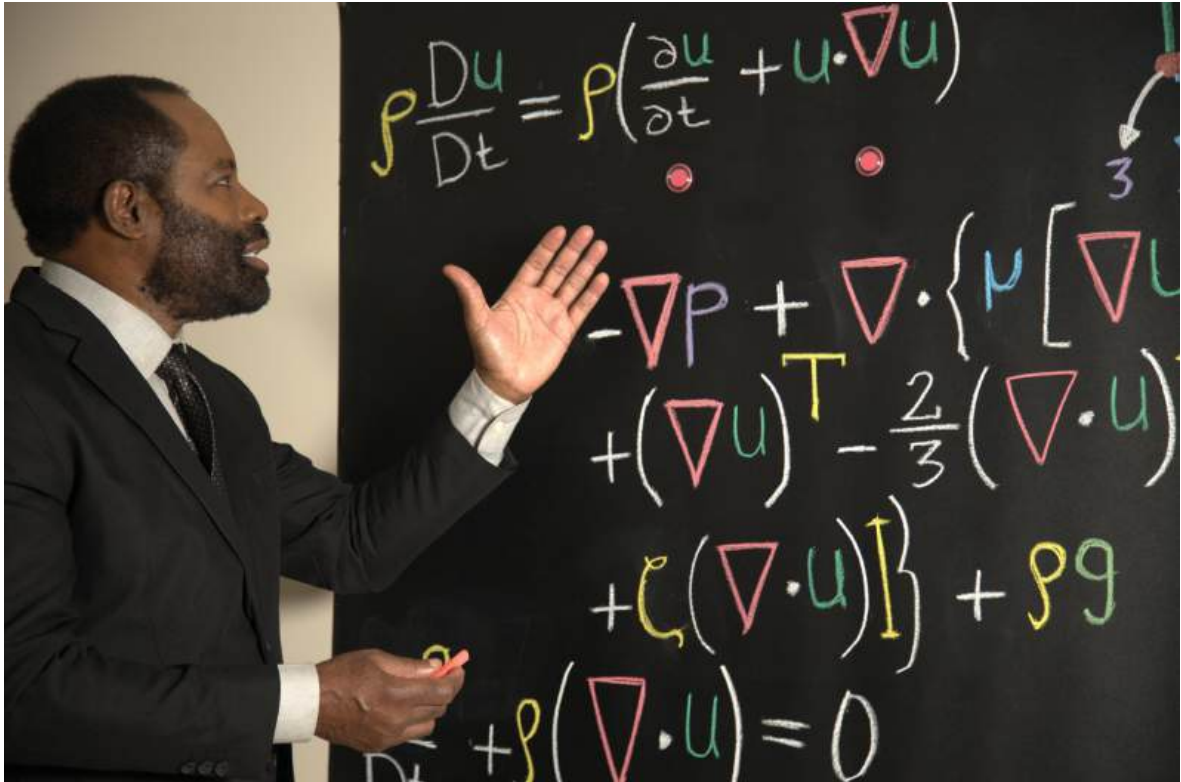
Philip Emeagwali at his blackboard explaining his contributions to partial differential equations of calculus and the fluid dynamics of physics, New York, October 2022.

UNSTOPPABLE ALLY FOR SOLVING COMPLEX PROBLEMS

My contributions to the physics used to pinpoint deposits of crude oil and natural gas were these: I discovered how to harness the millions of processors that power the world's fastest computer. And how to use them as one coherent computing machinery that emulates the world's fastest processor that's one million times faster than a single processor solving the same problem alone.

The grand challenge of petroleum reservoir simulation was to compute the flows of crude oil and natural gas flowing from a water injection well to nearby producing wells. By making the news headlines, in 1989, my **invention** changed how we execute the mathematical calculations in extreme-scale computational physics.

It changed how mathematicians solve the most compute-intensive initial-boundary value mathematical problems, such as those arising in computational fluid dynamics. It changed how mathematicians solve them, in parallel. And solve them by distributing them **across** an ensemble of processors, instead of solving them in sequence. Or solving them only within one **isolated** processor that's not a member of an ensemble of processors.

My invention opened the door to how to solve the most compute-intensive mathematical problems. And solve them **across** an ensemble of millions of processors. And solve them when the governing system of equations of algebra had its nonzero entries only along its diagonal.

Putting Aside Antiquated Solutions and Exploring Novel Ways to Overcome Grand Challenges

My contributions to high-performance computational physics led to the discarding of the old way of solving the field's most difficult problems to the new way of solving them **across** an ensemble of up to one billion processors.

In the traditional way, physicists solved their toughest and their most compute-intensive initial-boundary value problems in computational physics. And solved them in sequence. Or solved one problem **at a time.** And solved that problem within one isolated processor that wasn't a member of an ensemble of processors that communicates and computes together. And do both as one seamless, coherent, and gigantic supercomputer.

In my new way, mentioned in the June 20, 1990, issue of The *Wall Street Journal* and in cover stories of top mathematics news journals, I **invented** how to solve 65,536 initial-boundary value problems of computational

fluid dynamics, such as the detailed global climate modeling. And solved them simultaneously.

In 1989, I was in the news because I **invented** how to solve the most difficult problems arising in physics and mathematics. And solve them in parallel. And I invented how to solve them **across** an ensemble of 65,536 coupled processors.

My signature contribution to supercomputing **is this**: I put to rest the saying that the world's fastest computing **across** the world's slowest processors is a beautiful theory that lacked experimental confirmation.

ENTERING INTO THE HISTORY BOOKS

 In 1989, I was in the news because I discovered why and how a million, or a billion, of the slowest processors in the world could be harnessed and used to create the fastest computer in the world that's used to solve many problems simultaneously, instead of solving one problem at a time.

The world's fastest computer powered by one billion processors is to me what the violin is to the violinist. I've been practicing the craft of programming supercomputers and doing so since June 20, 1974, in Corvallis, Oregon. After half a century of supercomputing, describing Philip Emeagwali as an overnight supercomputer wizard is like describing a man born on June 20, 1974, as a young boy.

From Average Phil to History Maker: How I Made My Mark on the World

A student writing an inventor biography report on my discovering the fastest computing asked me: "What course can I study to become the greatest computer genius?" That's like asking what book to read to become the greatest **violinist** or the greatest airplane pilot or the greatest soccer player or the best climber of Mount Everest."

When I was coming of age, in the 19**70**s and **80**s, the world's fastest computing across the world's slowest processors was mocked, ridiculed, and dismissed as science fiction. Since June 20, 1974, my grand challenge was to turn that fiction to actuality. Back then, asking a computer scientist to utilize one billion processors and use them to solve the most compute-intensive problems—such as the most detailed global climate modeling—was like asking a man who had never climbed a mountain to climb Mount Everest.

Once upon a time, and in New York City, a young violinist asked a taxi driver: "How do I get to Carnegie Hall?" The taxi driver replied: "Practice, practice, practice."

To become the **greatest** computer scientist, requires that you make the **greatest** contribution to the speed of the computer. And that **greatest** contribution is to discover a **never-before-seen** parallel and/or quantum computing way of making computers **faster.** And making supercomputers **fastest. A**nd to experimentally do both by recording a **never-before-seen** supercomputer speed increase. And using all that speed to solve the world's biggest problems. That supercomputer speed increase must make the news headlines. And must forever change how we look at the world's fastest computer.

THE UNPARALLELED BRILLIANCE OF THE EVERYDAY PERSON

 As a research supercomputer scientist who came of age in the 1970s and 80s and in the USA, the most important lesson that I learned was that you can't become a genius in supercomputing without foremost, applying "sitting power." I sat the longest in front of the massively parallel supercomputer of the 1980s that is, in reality, the supercomputer of today. That's the reason my lectures on my contributions to computing, mathematics, and physics are by far the most extensive ever posted on YouTube. The reason I could post my one thousand video lectures on YouTube was that I sat longer than any supercomputer scientist ever sat in front of supercomputers. In the 1980s, I was the lone programmer of the precursor to the world's fastest computer. applied the most "sitting power" upon the massively parallel supercomputer. And I applied that power more than any supercomputer scientist who ever lived.

A **violinist** must practice daily. The **violinist** must go beyond reading her music on her way to **Carnegie Hall,** New York City. The **violinist** must apply her "**sitting power**" to get to Carnegie Hall. This important lesson— of hard work, dedication, discipline, consistency, and practice—applies to everything we do in life.

You must play or think or dream soccer and do so every day before you can become a Super Eagle in the next World Cup. You must write daily before you can write your best-selling novel. Often, the best known writers wrote a million unpublished words before they publish their first one thousand words.

Since June 20, 1974, in Corvallis, Oregon, I have written a million words on partial **differential** equations, finite difference algorithms, message-passing codes, as well as lecture notes on my world's fastest computing that occurred on July 4, 1989, in Los Alamos, New Mexico, USA. In fact, the transcript of my one thousand podcasts and YouTube videos is a million words long. These original podcasts and videos are what sets me apart from the likes of **Albert Einstein**.

Supercomputer programmers believed my world's fastest computing **across** my ensemble of 65,536 processors. They've re-confirmed it **acros** an ensemble of ten million processors. People believe what they **hear** and **saw** and **understand**.

Chasing the Speed of Light: My Marathon Journey to Find the World's Fastest Computer

As a Black scientist who came of age in the 1970s, I was not welcomed to give public lectures, in places like Ann Arbor, Michigan. For instance, I gave a job hiring lecture on the world's fastest computing and on about September 24, 1985, in Ann Arbor, Michigan. The position was canceled after the white scientific community discovered that I was Black and African-born. The lectures that I shared on YouTube originated from the research that I conducted in the 1970s and 80s.

People believe their eyes and ears. During the past five centuries, the leading figures in physics—such as **Galileo Galilei**, **Isaac Newton**, and **Albert Einstein**—presented public lectures on their contributions to physics that made each physicist the subject of school essays.

I continued that five-century old tradition by posting one thousand podcasts and videos, each on my contributions to physics, mathematics, and computer science. For comparison, the most prominent scientists of modern times only post about ten videos on their "original" contributions to knowledge.

This hundred-fold gap between my podcasts and videos and theirs is because my contributions is far more complicated and is normally executed by a hundred-person research team.

Fifty Years of Advancing Supercomputing: Unveiling What Lies Beyond the Last Computer

I have been supercomputing since Thursday, June 20, **1974**. I began by programming one of the world's fastest computers at 1800 SW Campus Way, Corvallis, Oregon. That supercomputer was rated as the world's fastest computer in December **1965.** That supercomputer was the first to be rated at one million instructions per second.

Cover of letter to Philip Emeagwali at 344 NW 12th Street, Apartment 5, Corvallis, Oregon.

In the mid-**1980**s, I was the lone programmer of the **precursor** to the world's fastest computer that can solve up to a billion problems simultaneously. I was the lone wolf at the unexplored territory of the world's fastest computing, where sixty-four binary thousand off-the-shelf processors can solve 65,536 problems simultaneously**.** And do so after a **one-problem** to **one-processor** mapping and correspondence.

Before I could parallel program each of my two-**raised**-to-power **sixteen** identical processors and before I could compose their email primitives and before I could send my codes to and from those sixty-four binary thousand processors and send them across **sixteen** times two-**raised**-to-power **sixteen** regular, short, and equidistant email wires, I spent **sixteen** years honing my craft and doing so by building up my parallel **programming muscles**.

In the **1970**s and **80**s, I built up my intellectual muscles in physics, calculus, and computing. And built them up in the manner I built up my **physical muscles** and did so by playing tennis and lifting weights in the late afternoons.

You become a runner by running daily. You become a writer by writing daily. I executed the world's fastest computing by supercomputing daily. I

339

sat in front of the supercomputer for the sixteen years onward of June 20, 1974, in Corvallis, Oregon. And before *The Ann Arbor News* of Michigan profiled me in an article that was titled "computer wizard." That profile was dated April 26, 1990. So, it took me sixteen years to become genius.

For that reason, nobody was able to devote sixteen years to exactly replicate my experiments that yielded the world's fastest computing. Being ranked as the greatest computer genius is like being ranked as the greatest soccer player. You also have to play soccer for sixteen years before being voted as the world's number one soccer player.

In 1989, in Ann Arbor, Michigan, I was the only famous scientist. And the only inventor whose name and contributions were discussed on the record by the members of the Michigan House of Representatives. To this day, I am the only inventor from Michigan, or rather in the world, that posted one thousand podcasts and videos on his contributions to physics, mathematics, and computing. My lectures are on YouTube, Spotify, and Google Podcasts.

Quite often, those reviewing my contributions to mathematics cannot scribble the nine **Philip Emeagwali** equations. It's like someone who had never played a game soccer giving advice to the central defender of Nigeria's Super Eagles. The reason I alone could post a thousand YouTube videos was that I had fifty years of supercomputing behind those videos.

In June 1974, in Oregon, I dreaded the supercomputer. But after sixteen years, I won the highest prize in supercomputing. Computer scientists refer to my award as the Nobel Prize of supercomputing. The genius is the below average person that worked hard to become above average.

I built up my supercomputing muscles by coding in the mornings and coding supercomputers during the sixteen years that followed June 20, **1974**. Even on the days I don't have access to a supercomputer, I developed my algorithms and code fragments and wrote them in my parallel programmer notebooks.

Or, I researched linearized stability analyses of finite **difference** approximations of partial differential equations. My stability analyses were my, *a priori*, theoretical investigations of the exponential growth in mathematical errors as well as sensitive dependence on initial conditions for my governing system of partial **differential** equations.

Those equations and their discrete approximations are akin to the ones that define the **initial-boundary value problems** which I solved across my new global network of sixty-four binary thousand processors that defined my new Internet. It was after five decades of supercomputing that I became comfortable with the title "supercomputer scientist."

I'm the subject of school essays for my contributions to the speed of the computer. My contribution was that I discovered how to execute the world's fastest computing. And do so **across** the world's slowest processors. My invention is a milestone in physics, mathematics, and

computer science. The fastest computer in the world is the heavyweight champion of the computer world.
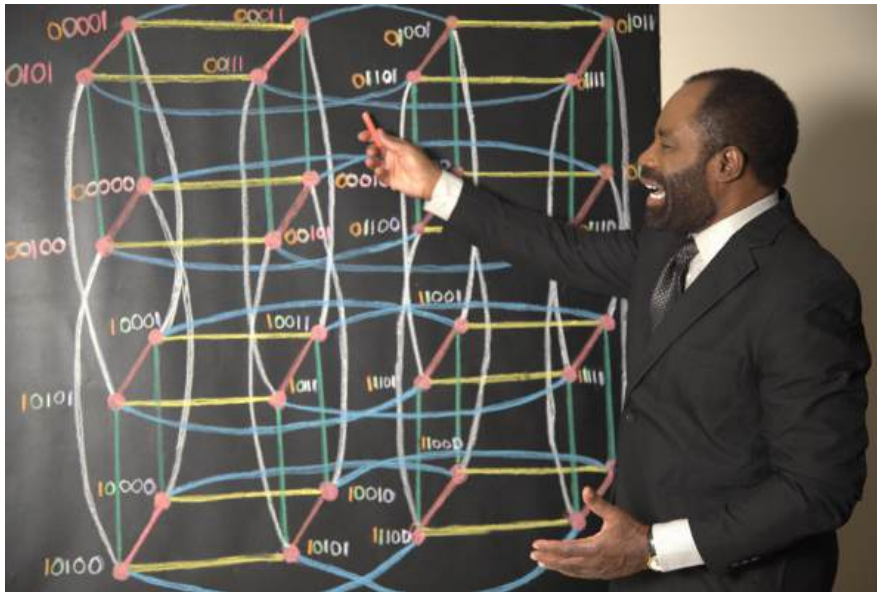
Philip Emeagwali explaining how he invented the world's fastest computing by parallel processing, New York, October 2022.

3RD LECTURE: WHAT THE HECK IS A CPU?

Philip Emeagwali, Washington, D.C., May 1979.

Broadcast 19 August 2021

https://youtu.be/gESTCFlxQHg

EXPLORING THE FASTEST COMPUTER AT THE SPEED OF LIGHT

My contributions to computer science were these: I discovered how to circumvent Amdahl's law that was the "sound barrier" of world's fastest computers. And how to do so by dividing the most challenging problem in supercomputing that's defined around a globe and dividing it into 65,536 lesser challenging problems. And then using a new Internet that's a new global network of the 65,536 slowest processors in the world and re-configuring that Internet to be massively parallel to those 65,536 problems. My mapping also possesses a one-to-one, processor-to-problem correspondence between that new Internet and the 65,536 smaller problems.

I discovered that the Amdahl's law limit described in computer science textbooks wasn't a physical limit within my new world's fastest computing **across** the world's slowest processors. Amdahl's law was a limit maintained by our lack of knowledge of how to make one billion processors to be parallel to one billion problems created by dividing one Grand Challenge problem into one billion lesser challenging problems.

My signature scientific discovery made the news headlines shortly after it occurred in Los Alamos, New Mexico, USA. My discovery occurred at 8:15 on the morning of the Fourth of July 1989. My invention, called the world's fastest computing, was the new knowledge that supercomputer designers must use to push Amdahl's limit and do so by a factor of 65,536, or as many billions.

I discovered how to achieve a billion-fold increase in the speed of the world's fastest computer. And do so **across** a billion processors. Before my discovery that occurred on July 4, 1989, the designers of the world's fastest computers and the authors of computer textbooks believed parallel supercomputing will forever remain in science fiction. Looking farther in time, I believe that quantum computing could be the next fundamental change, although it would have limited applications.

Overcoming the Obstacles of Solving the Most Difficult Problems Across the Slowest Processors

I invented how to harness a new Internet which I visualized as a new global network of the 65,536 slowest processors in the world. I discovered how to use each processor to solve a system of 366 equations in large-scale algebra. Those equations originated from my finite difference approximations of some initial-boundary value problems of calculus and

from my computer programming that yielded extreme-scaled computational fluid dynamics codes, such as those used to simulate production petroleum reservoirs that might be up to 7.7 miles (or 12.4 kilometers) below the surface of the Earth and the size of **Ibadan, Nigeria**.

The intractable equations that I solved, in 1989, was a milestone in the history of algebra. And was in the news because, in totality, it then comprised of a world-record 24 million equations of computational linear algebra. My system of 24 million equations was **unsolvable** by a human computer. And can't be solved in a lifetime. And was **unsolvable** across all the blackboards in the world.

My Supercomputer Breakthrough Explained

One reason my invention made the news headlines was that I mathematically discovered the algorithm—or the set of instructions and emails—used to solve the largest system of equations that ever occurred in algebra. I succeeded in **1989.** At that time, 25,000 the vector supercomputer scientists in the world and their leader, **Seymour Cray**, had given up on harnessing millions of processors. And using them to execute the world's fastest computing. And solve the most complex problems arising at the crossroad where new mathematics, new physics, and the world's fastest computing **intersected**.

In the 1980s, the fastest computing **across** the slowest processors existed in science fiction, not in computer science. For that reason, parallel processing was then not the high-performance computing instrument of choice for solving initial-boundary value problems from the fields of extreme-scale algebra and computational physics.

In the **1980**s, those 25,000 computational mathematicians **ridiculed** parallel supercomputing and **dismissed** the then newly emerging technology as a tremendous waste of everybody's time. I was cover stories of top science publications because I discovered how to harness the slowest processors in the world and use them as one seamless, coherent supercomputer that enabled me to record the fastest computer speeds in the world. And record them while solving the most compute-intensive problems in the world.

That contribution to the speed of the computer is the subject of school essays. In the 1980s, I didn't merely solve a system of 366 equations of computational linear algebra and solved that system within one processor. **In totality**, I solved a system of 24 million equations that was the longest in mathematics.

And solved that system **across** a new spherical island of 65,536 processors. I programmed each processor to solve a system of **366 equations** of computational linear algebra. My processors were identical and were equal

distances **apart**. Each algorithm I executed within each processor described my step-by-step instructions to each processor. I instructed each processor on how to solve my system of 366 equations of computational linear algebra.

That system arose from another system of coupled, nonlinear partial **differential** equations of calculus, called the nine Philip **Emeagwali** equations. I emailed my system of 366 equations to each of my 65,536 processors. I discovered how to email my sixty-four binary thousand computational fluid dynamics codes. Each code was governed by a system of 366 equations of linear algebra that was at its compute-intensive **kernel.**

Philip Emeagwali, New York, October 2022.

UNLOCKING SUPERCOMPUTING ACROSS INTERNET

 The supercomputer must be used to model the long-lasting cultural, social, and economic impacts of global pandemics, as well as simulate subsequent changed realities. In the textbooks on computational fluid dynamics, animating a sneeze is nothing new. In the 1980s, supercomputing across up to one billion processors, each its own master, that shared nothing was revolutionary.

I visualized the world's fastest computing that I discovered across a new internet as occurring across a global network of the world's slowest processors. And as metaphorically occurring at equidistant points on the surface of the sphere. I defined those points as where the computing vertices of the tightly-inscribed cube come into contact with the circumscribing sphere.

I visualized the cube and sphere in the fifth dimension. And I progressively increased my visualization to the sixth, seventh, and sixteenth dimensions. Finally, I hypothesized "what ifs" in the 64th dimension.

I visualized the Philip Emeagwali Internet as a global network of two-raised-to-power five, or thirty-two, computers that outlined a hyper-globe in as many dimensional hyperspace. What made the news headlines was my world's fastest computing which I envisioned in the sixteenth-dimensional hyperspace.

That was how my story that was a mere acorn, back on June 20, 1974, and in the hands of a nineteen-year-old at 1800 SW Campus Way, Corvallis, Oregon, USA, grew to become a mighty oak tree. That tree was my metaphor for my new Internet that's a new global network of 65,536 equidistant processors.

Defeating the Hardest Algebraic Problems

I discovered how to email computational fluid dynamics codes, such as global climate models. And how to email them to millions of processors. In my experiment of July 4, **1989**, I used the slowest sixty-four binary thousand, or two-**raised**-to-power sixteen, processors in the world to record the fastest computer speeds in the world. Each processor was uniquely identified by a sixteen-bit-long number.

That number was a unique string of sixteen zeroes and ones. **That number** had no @ sign or dot com suffix. **That number** was the email address of each of my two-**raised**-to-power sixteen coupled processors that were **married together** as one cohesive unit by sixteen times two-**raised**-to-power sixteen regular, short, and bidirectional email wires that were equal distances **apart**.

I invented invisible, byte sized instructions for each processor. I gave each processor its step-by-step instructions, or algorithms, that it used to solve a system of equations of computational linear algebra that I emailed to it **arising from** a system of equations of calculus **arising from** laws of physics **arising from** a computational mathematician's quest for new calculus, new algebra, and new computing.

Pushing Through the Pain: My Toughest Years in Supercomputing

My mathematical quest for the world's fastest computing **across** the world's slowest processors, began on Thursday, June 20, **1974,** in Corvallis, Oregon, USA. And ended on Tuesday, July 4, **1989,** in Los Alamos, New Mexico, USA.

Philip Emeagwali (2nd from right of second row), Wilson Hall, Oregon State University, Corvallis, Oregon, from the university's 1976 BEAVER Yearbook.

347

The calculus book is where the mathematician of European ancestry recognizes his ancestors, such as **Isaac Newton** of England who lived three centuries and three decades ago and **Isaac Newton**'s contemporary, **Gottfried Leibniz,** who lived in Germany. I'm a research computational mathematician of sub-Saharan African ancestry who contributed thirty-six partial derivative terms to the nine Philip **Emeagwali** equations of calculus.

I was in the news because I discovered how to solve initial-boundary value problems in calculus and physics, such as the highest-resolution global climate modeling that's a precondition to foreseeing otherwise unforeseeable long-term global warming.

My Early Years as a Supercomputer Scientist in the USA

As a Black mathematician in the USA, I wasn't welcomed by white mathematicians. That's why I conducted my research alone. And did so as a large-scale computational mathematician who came of age in the **1970**s in Oregon and Maryland. And in the 19**80**s in the District of Columbia and Wyoming.

Due to its price-tag of one **billion** two hundred and fifty million dollars, the world's fastest computer cannot be owned by just one school. For this reason, a computer science instructor can only use a desktop computer to conduct his or her instructions and research.

In contrast, I used sixteen supercomputers during the sixteen years that followed June 20, 1974, in Corvallis, Oregon, USA. That research culminated in my discovering the world's fastest computing which occurred **across** the world's slowest processors. And it occurred on July 4, 1989, in Los Alamos, New Mexico, USA.

Philip Emeagwali, New York, October 2022.

FASTEST COMPUTING FROM SLOWEST PROCESSING

Physics of the Unseen

In the **1970**s and **80**s, supercomputer scientists believed that solving the most compute-intensive problems in science and engineering and solving them **across** an ensemble of millions of processors will forever remain within science fiction.

In the **1970**s, I visualized the world's fastest computing **across** a new Internet that I envisioned as a new global network of processors. In the **1980**s, I discovered how to program a new global network of 65,536 off-the-shelf processors. And I discovered how to use them to solve the most compute-intensive problems in extreme-scale computational fluid dynamics. I discovered a speed increase of a factor of 65,536.

I was in the news because I discovered that speed increase and did so at a time it was considered impossible to achieve a speed increase of a factor of eight and record it **across** up to a billion processors that's cooperatively solving the most compute-intensive problems at the crossroad where mathematics, physics, and computer science intersected.

I Was the Elephant in the Room: Learning to Speak Up in the Face of Silence

I began supercomputing at age nineteen on June 20, **1974**, in Corvallis, Oregon, USA. Corvallis is an American city in the **Willa**mette Valley. Corvallis is not in the rain forest. But, in Corvallis, it rains almost daily and for five months of the year. Or rather it drizzles constantly in Corvallis.

Within the U.S., Corvallis is rated as a top ten bicycle friendly town. In Corvallis, I rode my red two-speed bicycle, covering a distance of twenty miles each day.

In **1974**, Corvallis had only one Black homeowner in its populace of 36,000. The reason was that it was challenging for a Black homeowner to buy a house in a white neighborhood. I was asked: "What was it like to be a Black supercomputer scientist in Oregon?"

In the **1970**s, there were few supercomputer scientists in the world. By the late **1980**s, the number of vector supercomputer scientists has grown to 25,000. In the **1980**s, I was the only full-time massively parallel supercomputer scientist in the world. I alone then controlled sixteen massively parallel supercomputers. I used those supercomputers to conduct my parallel computing research on how to solve the most compute-

intensive initial-boundary value problems, such as those arising in computational fluid dynamics.

My quest was to become the first to figure out how to solve such mathematical problems and do so **across** an ensemble of the slowest processors in the world. And solve such Grand Challenge problems at the fastest speeds in the world. The modern supercomputer—powered by a million processors—is the "North Star" for mathematicians and scientists seeking a deep understanding and new way to treat brain disorders like schizophrenia, Alzheimer's, epilepsy, autism, and traumatic brain injury.

A Journey of Refusal: How I Was Disinvited from White Science

By **1989**, I was supercomputing in Los Alamos, New Mexico, USA. A dozen years earlier, I was supercomputing in Washington (District of Columbia), Baltimore (Maryland), and Laramie (Wyoming). Yet, I could only name three Black supercomputer scientists. They were me, myself, and I.

In the **1980**s, I was often invited to give supercomputing lectures on my hoped-for invention of how a machinery that's powered by the world's slowest processors could be harnessed as the fastest computer in the world. But I was often disinvited from giving those supercomputing lectures. And disinvited after the supercomputing seminar organizers discovered that I was Black and sub-Saharan African. At mathematics research seminars in College Park (Maryland) of the early **1980**s, I was the elephant in the room who felt like an uninvited guest.

Philip Emeagwali, Baltimore, Maryland (~ December 1983).

Changing the Game: How I Changed the Way We Look at the Fastest Computers

For the four decades following the first programmable computer of **1946** that was the world's fastest then, inventing a parallel supercomputer that's just as tough under the hood has proven elusive to the supercomputer

352

industry. In the history of technological progress, any paradigm shift that changed how we looked at the computer earned its inventors both kudos and daggers.

The leaders of thought in the computing who were **Gene Amdahl** of Amdahl's law fame, **Seymour Cray** of vector supercomputing fame, and **Steve Jobs** of personal computing, were against the new **paradigm** of parallel supercomputing. **Before** I became famous for my discovering the world's fastest computing **across** the slowest processors in the world or **before July 4, 1989**, no respectable supercomputer scientist would accept my phone call.

After July 4, 1989, I was amazed at their reactions when I walked into a roomful of vector supercomputer scientists. Because my fastest computing across the slowest processors was a paradigm shift that will change how we look at the fastest computers and because supercomputing **across** a billion processors and doing so to solve the most compute-intensive problems seemed impossible in the **1980**s, nobody else would touch parallel processing and do so with a ten-foot pole.

In the 1980s, the fear and lack of understanding of parallel processing were the reasons five scientific groups asked me to leave their research teams. Before my invention, the research groups that humiliated and dismissed me believed a supercomputer could only solve one problem **at a time**, instead of solving 65,536 problems simultaneously and **across** as many processors that each had its dedicated memory.

I invented the first supercomputing across millions of processors. That new knowledge is used to solve the most compute-intensive problems in computational fluid dynamics. And used to solve discretized initial-boundary value problems of calculus.

In the 1980s, I was dismissed from scientific research teams that believed in sequential supercomputing. Those dismissals became the metaphors for my struggles.

CHANGING THE WAY WE LOOK AT THE INTERNET

A Whole New World of Possibilities

 Massively parallel processing is the new supercomputing engine that powered the big leap forward that enabled the supercomputer industry to leapfrog from traditional supercomputers powered by one customized processor to the world's fastest computers powered by a gargantuan spherical island of a billion off-the-shelf processors. I invented that global network of off-the-shelf processors as a small copy of the Internet. On February 1, 1922, and sixty-seven years earlier, this supercomputing machinery was first written as the stuff of sci-fi fantasy. A century ago, the fastest computing acrossthe slowest humans was speculated as science fiction comprising of 64,000 human computers used to forecast the weather for the entire Earth.

Fast-forward sixty-seven years to 1989, I was in the news for experimentally discoverin g how and why parallel supercomputing should become the core technology that will change how we look at both the computer and the Internet. And change how we use both technologies to work and play.

The Supercomputer and the Scientist: A Powerful Combination

Parallel supercomputing is the new discovery that enables the world's fastest computer to perform computations that's up to a billion times faster than its predecessor. Parallel supercomputing makes it possible to solve the most difficult problems that were, otherwise, impossible to solve.

The fastest computing was my quest to be the first member of humanity to understand how to compute and do so at the world's fastest speeds. I invented how to email one billion codes to one billion processors. And email them with a one-code to one-processor mapping and correspondence.

My discovery that occurred on the Fourth of July 1989 was the new knowledge that enabled the computer industry to reach new heights. And enabled scientists to discover new and improved ways of concurrently solving the most compute-intensive problems at the *terra incognita* where new mathematics, new physics, and new computer science intersect.

This new reality, or discovery, wasn't reserved for mathematics and physics. This new fastest supercomputing knowledge made the news headlines because it enriched science, engineering, and medicine. And because it allows the world's fastest computers to do more with less money.

Philip Emeagwali Computer: Re-Engineering the Internet as the Planetary Supercomputer

My discovery was mentioned in the June 20, 1990, issue of *The Wall Street Journal* simply because I was the only person that proved he understood the science-fiction supercomputer. And did so by recording the world's fastest computing speed **across** an ensemble of the world's slowest processors.

My invention made the news headlines because to discover that the fastest computer can be built with the slowest processors was a scientific discovery that changed computer science. My discovery was recognized as a contribution to the speed of the computer. Parallel processing is the foundational knowledge of the fastest computers. If history repeats itself, parallel supercomputing could become the computing of the future that's defined **across** the Internet of the future. Massively parallel processing could make it possible for an Earth-sized supercomputer to become a subset of the Internet itself.

My invention of the fastest computing is summed: The world's slowest processors can cooperatively compute together to yield the fastest computations ever recorded. And to solve the most compute-intensive problems in the world.

Unlocking the Secrets of Unrivaled Speed: Quantifying the Performance of the World's Fastest Computers

It was impossible to discredit my scientific discovery of parallel supercomputing largely because it was new knowledge derived from objective and quantifiable metrics. That objective metric **was this**: The speed increase of a factor of 65,536 that I discovered on July 4, **1989**, and discovered **across** my as many **off**-the-shelf processors was higher than the maximum speed increase of a factor of eight theorized in supercomputer textbooks.

My invention of the fastest computing opened the door to the world's fastest computer of today that could become the laptop computer of tomorrow. And, since my discovery of July 4, **1989**, the number of supercomputers that computes in parallel increased in geometrical proportion.

My discovering the world's fastest computing that occurred at fifteen minutes after 8 o'clock on the morning of the Fourth of July **1989** was the

big-bang moment for the world's most powerful computers.

The supercomputer is an instrument of modern science. The supercomputer is the scientist's best friend. The supercomputer technology has a market value of forty-five billion dollars a year. Supercomputers are used as enabling instruments for physics-based modeling and simulation. Supercomputers are used to make scientific discoveries and achieve technical breakthroughs, such as gaining a deeper understanding of how global warming will occur **across** the centuries.

Leaving a Legacy: How I Want to Be Remembered

Recording the world's fastest computing speed and doing so **across** a supercomputer that's as large as the Earth is a race to new knowledge that's more important than the race to put a human being on planet Mars. Today, the world's fastest computer has twenty million times more punch than your computer.

Parallel supercomputing is not a magic cure all. However, parallel processing is **embodied** in most computers and in all supercomputers. **Parallel processing**—that was once a dim light in a sea of darkness is now the **bedrock** of the world's fastest computers. **Parallel processing**—that was once the stone rejected as rough and unsightly—has become the headstone of the supercomputing industry.

A journalist asked me: "How do you want to be remembered?" I answered: "Discoverers and inventors are remembered longer for their discoveries and inventions than for their prizes and medals. The scientific discovery is an eternal truth while the invention is a physical manifestation of the truth."

UNVEILING MYSTERIES

The Whispering Secrets of Fluid Dynamics

Dear esteemed members of the Award Committee, venerable academics, revered guests, and dedicated aspirants of knowledge from the global expanse, I approach you today with deep respect and humility as Philip Emeagwali.

This afternoon, allow me to guide your imaginations and contemplative spirits through the intricate weave of a hypothetical reality—a canvas where the sophisticated brushstrokes of computational fluid dynamics (CFD) are glaringly absent.

I was asked: What is the contribution of Philip Emeagwali to physics?

I contributed the use of supercomputers in physics by discovering how the extreme-scaled climate model is parallel processed across a new Internet that's a new global network of 65,536 processors. And how global climate models can be executed by chopping up the model of the Earth's atmosphere and oceans into 65,536 smaller climate models that're mapped with a one-model to one-processor correspondence. And mapped onto as many processors. CFD comprised my testbed codes that led to my unexpected discovery of parallel supercomputing, on July 4, 1989, in Los Alamos, New Mexico, USA.

CFD, with its majestic interplay of numbers, algorithms, and equations, serves not merely as a testament to human ingenuity but is a vital conduit, a translucent window through which we decipher the myriad dances and undulations of fluids, the lifeblood of our Earth's atmospheric, oceanic, and subterranean domains.

Picture a world where the silent, eloquent ballet of air currents, the whispering secrets of the deep blue oceans, and the subterranean rivers coursing through Earth's veins remain shrouded in impenetrable veils of mystery and enigma. Without the guiding hand of computational fluid dynamics, these tales remain untold, these symphonies unheard, these canvases unseen.

In the absence of CFD, our voyage through the cosmos of understanding becomes treacherous, with the compass of prediction rendered erratic and unreliable. Engineers and scientists, those valiant explorers of the tangible and intangible, would find themselves navigating through a mist of uncertainty, deprived of the ability to predict and modulate the behavior of gases and liquids with precision and foresight.

The intricate tapestry of meteorology, where the winds, clouds, and atmospheric tides weave tales of future weather patterns and climate trends, would be blurred, with the fine details lost and the overall picture obscured.

Without the clarion call of accurate weather prediction and climate modeling, humanity stands on the precipice of the unknown, gazing into an abyss where nature's wrath and benevolence are equally unpredictable.

In this alternative reality, the wings of airplanes, the hulls of mighty ships, and the turbines harnessing the wind's invisible might would be sculpted without the intimate understanding of the invisible forces caressing, buffeting, and interacting with them. The symphony of progress would miss notes, with each invention and innovation carrying the weight of uncertainty and approximation.

Yet, as we stand in the shadow of possibility, let us illuminate our minds with the acknowledgment that with the potent tool of CFD comes an inherent responsibility. It is incumbent upon us, the bearers of knowledge and the architects of understanding, to wield this power with wisdom, integrity, and a vision that is tinted with the hues of inclusivity, sustainability, and empathy for our planet and its myriad inhabitants.

As we traverse the corridors of contemplation, envisioning a world without computational fluid dynamics, let it be a reminder, a gentle, whispering wind in our ears that technology and knowledge are not merely shields and swords but are guiding stars, illuminating our collective journey towards a horizon brimming with the dawn of understanding and enlightenment.

Esteemed guests, let our reflections today not just be a mere exercise in intellectual whimsy but rather a clarion call for appreciating, nurturing, and responsibly using the gifts of technology and understanding, such as computational fluid dynamics, in crafting a tapestry that reflects our shared dreams, hopes, and aspirations for a future written with the ink of wisdom, care, and respect for all.

I thank you wholeheartedly for sharing this moment of reflection and vision with me.

Thank you.

7 02

Episode 231103-5-philip-emeagwali

THE DIGITAL TWIN OF THE OCEAN

Building a Virtual World for Research and Prediction

Ladies and gentlemen, distinguished guests, and fellow science enthusiasts,

Tonight, as we stand on the precipice of a new era in scientific discovery, I, Philip Emeagwali, am deeply honored to share the secrets of a mathematical model that has revolutionized our understanding of our planet's vast and mysterious oceans. This model, known as the shallow water equations, has unlocked a world of knowledge about ocean currents, tides, storm surges, and the intricate dance of water that shapes our climate and environment.

Unveiling the Shallow Water Equations

Imagine the ocean as a vast, interconnected web of fluid motion, driven by the forces of wind, gravity, and the Earth's rotation. The shallow water equations, derived from the fundamental laws of physics, provide a potent tool to decipher this intricate dance.

These equations are built upon two core principles:

Conservation of Mass: Just as a drop of water cannot disappear into thin air, the mass of water within a given region of the ocean must remain constant. This principle is encoded in the continuity equation, which tracks the flow of water in and out of a control volume.

Conservation of Momentum: Physics's second law of motion, the bedrock of classical mechanics, tells us that the acceleration of a fluid parcel is proportional to the net force acting upon it. The momentum equations, two equations for the two horizontal directions, express this principle in the context of ocean currents, accounting for forces like pressure gradients, the Coriolis effect (caused by the Earth's rotation), and bottom friction.

By combining these principles, we arrive at the shallow water equations, three partial differential equations that describe the evolution of the ocean's surface height and horizontal velocities over time and space.

Harnessing the Power of Supercomputing

Solving these equations for realistic ocean domains requires immense computational power. Enter the modern supercomputer, a marvel of engineering that harnesses the combined might of millions of interconnected processors. This massively parallel architecture allows us to divide the computational workload into smaller tasks that can be executed simultaneously, drastically reducing the time required to obtain solutions.

By leveraging this computational power, we can create high-resolution models of the ocean, simulating its behavior with unprecedented detail and accuracy. These models are essential tools for understanding ocean circulation, predicting tides and storm surges, and assessing the impact of climate change on our coastal communities.

From Weather Forecasts to Climate Models

The applications of the shallow water equations are vast and far-reaching. In weather forecasting, they are used to predict storm surges, which can cause devastating coastal flooding. In oceanography, they are used to study the dynamics of currents, eddies, and waves, providing valuable insights into the ocean's role in climate regulation.

But perhaps the most significant application of the shallow water equations lies in climate modeling. By incorporating these equations into global climate models, we can simulate the intricate interactions between the atmosphere and the ocean, gaining a deeper understanding of the Earth's climate system and its response to human-induced changes.

The Internet: A Global Network of Processors

My discovering the first world's fastest computing across many connected processors—on July 4, 1989—opened the door to the massively parallel supercomputers. Parallel processing played a role crucial role in advancing climate modeling. By programming the slowest 65,536 processors in the world to solve the most difficult problems in mathematics and physics, I was able to discover an unprecedented levels of computational power, enabling the scientific community to tackle complex problems like climate simulation that were previously intractable.

The Internet, itself a global network of interconnected processors, has further democratized access to computational resources, enabling scientists and researchers from all corners of the globe to collaborate and share data, accelerating the pace of scientific discovery.

A Vision for the Future

As we look to the future, the shallow water equations and the power of supercomputing will continue to play a vital role in our understanding of the ocean and its impact on our planet. With continued investment in research and development, we can unlock even deeper mysteries, develop more accurate models, and make informed decisions that will safeguard our planet for generations to come.

In the spirit of scientific inquiry and collaboration, let us continue to push the boundaries of knowledge, harness the power of technology, and work together to create a more sustainable and resilient future for all.

Thank you.

FORECASTING THE UNKNOWN

Vision of a World Without Weather Forecast Models

Distinguished members of the Award Committee, esteemed scholars, revered guests, and cherished friends from all horizons of our interconnected globe, it is with great humility and a sense of profound honor that I, Philip Emeagwali, stand before you today.

In the sacred conclave of minds that gathers here, I invite you to traverse with me through a hypothetical canvas, a dimension where the sophisticated brushstrokes of weather forecast models are absent, leaving behind a tableau that is unpredictably raw and inherently uncertain.

My mathematical contributions to the solution of the primitive equations used to forecast your evening weather were these: I discovered how to parallel process and compress the time needed to solve that Grand Challenge problem of weather forecasting that is an extreme-scale initial-boundary value problem of computational physics.

I discovered that with 42 million processes computing in parallel , a time-to-solution of 42 million days, or 120,000 years, dropped to one day of time-to-solution across a new Internet that's a new spherical island of 42 million processors that were interconnected yet autonomous. Without parallel supercomputing, tomorrow's weather forecast will be issued 1,000 years later.

Weather forecast models, dear compatriots in the pursuit of knowledge, are not merely assemblages of equations and algorithms that predict the capricious behavior of our atmosphere. They are, indeed, our guiding stars, the oracles that allow humanity to glean into the future, preparing and positioning itself against the mutable tides of atmospheric conditions.

Envision with me a world stripped of the prescience offered by weather forecast models. It would be a scenario wherein every dawn conceals within its bosom unpredictable challenges, where every swirl of wind and every congregation of clouds is not a harbinger but a mystery unveiling itself in real-time, often with little room for preparation or prevention.

In the absence of weather forecast models, our farmers, the venerable cultivators of nourishment, would sow seeds and anticipate harvests in a gamble with the skies, their livelihoods oscillating with the pendulum of meteorological whims. The lack of forecast models would affect their yields and impact the global food supply chain, engendering precariousness and instability.

Our civil protection agencies and emergency responders would navigate through a fog of uncertainty, often caught unprepared by the sudden onset of storms, hurricanes, and other extreme weather events. The absence of warning would invariably result in greater losses, both in terms of precious human lives and invaluable assets.

Without the prudence offered by weather forecast models, sectors ranging from aviation to maritime navigation, from event planning to construction, would all find themselves playing a high-stakes game of roulette with the atmosphere, the outcomes of which could be benign or catastrophic.

However, this speculation should be an academic meditation on the absence and a clarion call to recognize the implicit responsibility that accompanies our capabilities. With the power to predict comes the duty to prepare, respond, and mitigate effectively and equitably, ensuring that the benefits of weather forecasting are accessible and available to all, irrespective of geographical or socio-economic boundaries.

As we ponder upon a world without weather forecast models, let this reflective exercise also serve as an affirmation of our commitment to the conscientious application and continuous improvement of these tools. It is a commitment not just to technology but to humanity, to the safeguarding of lives and livelihoods against the vagaries of weather.

I extend to you, my esteemed colleagues and dear friends, a heartfelt expression of gratitude for engaging with me in this intellectual exploration. Together, under the guidance of our accumulated knowledge and shared responsibility, let us continue to charter through the atmospheric tides with foresight, preparedness, and a deep respect for the natural forces that surround us.

Thank you.

6 26

Episode 231104-1-philip-emeagwali

NAVIGATING THE CLIMATE ABYSS

A World Without General Circulation Models

Esteemed members of the Award Committee, distinguished scholars, revered guests from every corner of the globe, and steadfast companions in the shared quest for understanding, I greet you warmly as Philip Emeagwali.

Today, I beseech you to join me on a contemplative expedition, as we envision a reality devoid of the guiding lights of parallel general circulation models (GCMs). These models, often operating quietly in the recesses of our scientific endeavors, are the unsung heroes, the vigilant sentinels mapping the atmospheric and oceanic currents that whisper the tales of our climate and environment.

I was in the news, in 1989, for discovering that the fastest computing across millions of processors is indispensable and fundamental for solving partial differential equation of calculus.

And for executing the most extreme-scale computational fluid dynamics codes, including global climate modeling that's always a precondition to predicting long-term global warming. I discovered the fastest computing across the slowest processors. And did so at 8:15 on the morning of Tuesday, July 4, 1989 in Los Alamos, New Mexico, USA.

The world's fastest computer is to the climate scientist what the world's most powerful telescope is to the astronomer. The supercomputer changed how we solve compute-intensive problems. In their old way, they solved compute-intensive initial-boundary value problems of computational physics in sequence. Or solved one problem at a time. And solve that problem within one isolated processor that wasn't a member of an ensemble of processors that were communicating and computing together and doing both as one seamless, coherent, and gigantic supercomputer.

In a world absent of parallel general circulation models, we find ourselves navigating the intricate dance of climate and weather without a compass, with the fabric of atmospheric patterns and oceanic currents unfolding around us in spectacular, although bewildering, complexity.

Without GCMs, our understanding of climate dynamics would be akin to perceiving the vibrant strokes of a painting in the darkness, with the nuanced interplay of temperature, pressure, humidity and wind remaining elusive, distant—a symphony whose melody we discern but whose notes remain enigmatic.

GCMs serve as the lexicon, the vocabulary through which we engage with and interpret the oscillations of our planet's climate. Without these models, the language of climate becomes indecipherable, its whispers and roars

363

reverberating through the atmosphere without a translator to render them intelligible to the human mind.

Imagine the endeavor of predicting and understanding climate change, that monumental challenge that stands before humanity like a mountain, without the tools provided by general circulation models executed on supercomputers. Our approach would be impeded, our strategies formed in the mist of uncertainty, and our responses, although well-intentioned, lacking the precision and foresight necessary to address the multifaceted implications of a changing climate effectively.

However, while we acknowledge the indispensability of GCMs, it is crucial to approach these tools with humility, awareness, and a sense of profound responsibility. For models, as representations of reality, bear within them the dual potential of illumination and misinterpretation. It falls upon us, the stewards of science and knowledge, to wield these models judiciously, critically, and ethically.

As we ponder a world without general circulation modeling on supercomputers, let this thought exercise also kindle within us a renewed commitment to leveraging these invaluable tools with care, diligence, and an unerring dedication to advancing understanding, fostering sustainability, and safeguarding the future of our precious planet.

Dear colleagues, as we stand on the brink of tomorrow armed with the power and potential of the parallel processing of general circulation models, let us move forward with hope in our hearts and wisdom in our actions, continuing the venerable tradition of exploration, discovery, and enlightenment for the benefit of all humanity.

I extend my deepest gratitude for your attention and your shared passion for knowledge and understanding. Together, let us embrace the opportunities and challenges that lie ahead, guided by the compass of science and the light of curiosity.

Thank you.

6 49

Episode 231104-2-philip-emeagwali
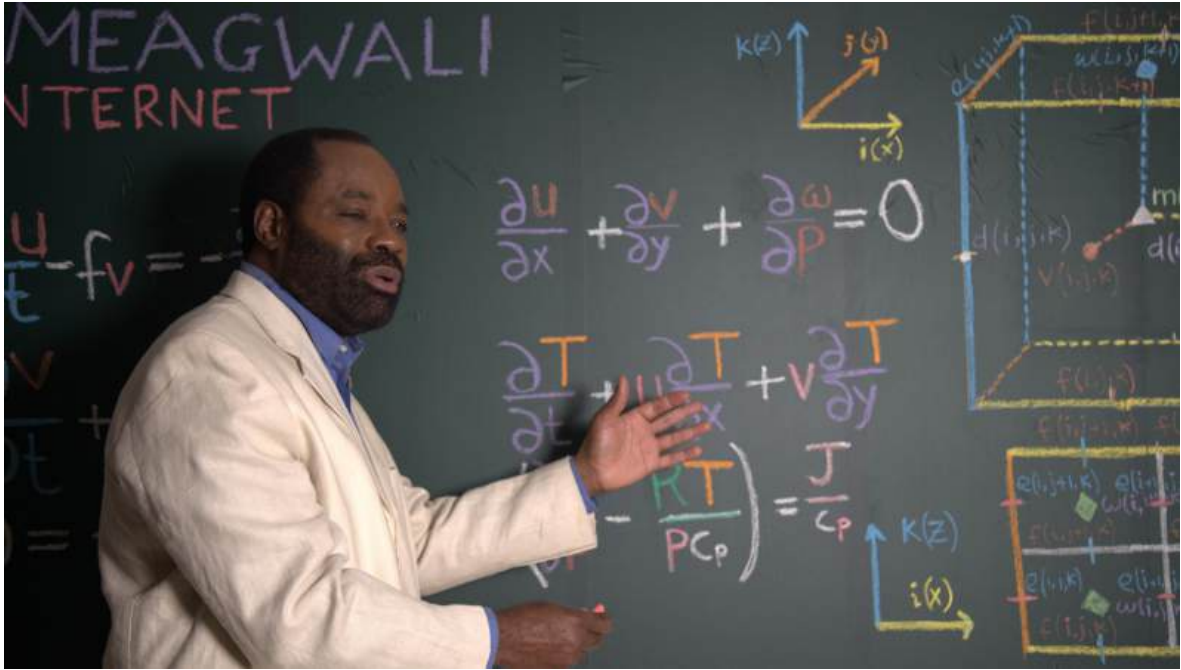
WAVES IN THE DARK

Navigating Petroleum Extraction Without Simulation

https://www.youtube.com/watch?v=ngYR2LbwbCg

https://open.spotify.com/episode/6MtAyLnwQfr39awqmIEASJ

Distinguished members of the Award Committee, respected scholars, esteemed guests, and treasured global citizens, I address you with profound humility and gratitude as Philip Emeagwali.

In the symphony of progress, each note, each harmony plays a critical role in crafting the melodic masterpiece that we cherish as advancement. Today, let us focus our intellectual lenses on one such harmony, exploring the hypothetical realms of a world absent of petroleum reservoir simulation on a supercomputer.

The petroleum industry stands as the backbone of many economies, notably Nigeria. By drastically enhancing our capability to locate and extract crude oil and natural gas and do so more efficiently, we can revitalize national economies, fuel growth, and, crucially, redirect resources to uplift the marginalized, alleviate poverty, and catalyze holistic development. It's a ripple effect; by boosting the prosperity of oil-producing nations, we bolster the global economy, driving progress and prosperity.

I was asked: What is the contribution of Philip Emeagwali to the oil and gas industry? Before my discovery of July 4, 1989, computers powered by only one processor were used by the petroleum industry. After that discovery, all supercomputers are powered by up to 42 million processors that were interconnected yet autonomous. One in ten supercomputers are now purchased by the petroleum industry.

Petroleum reservoir simulation, dear audience, is not a mere technological lexicon, but a vibrant, pulsating heart of the energy sector, an invisible hand that deftly molds and guides our understanding and extraction of the black gold "petroleum" that fuels our civilization.

Picture a world where the subterranean labyrinths holding these precious hydrocarbons are enigmatic, elusive. **Without the guiding beacon of petroleum reservoir simulation on the world's fastest computers, our approach to unearthing petroleum would be akin to fumbling in the proverbial darkness, with uncertainty and inefficiency as our undesired companions.**

The art and science of extracting petroleum is a complex tapestry, a delicate balance of pressure, volume, and temperature, a dance of physics and chemistry occurring in the deep, silent cradles of Earth. Petroleum reservoir simulation is our interpreter, translating the whispers and murmurs of the underground into a language, a narrative that engineers and scientists can comprehend, analyze, and act upon.

Without it, the symphony falters; the dance loses its rhythm. The process of petroleum extraction would not only be perilously inefficient but environmentally detrimental, risking the sanctity of our beloved planet's ecosystems, air, and water. The absence of precise simulation would inadvertently cast a shadow of waste, pollution, and heightened economic expenditure, making energy a scarce and dear commodity, inaccessible and unaffordable to many.

Furthermore, the very endeavor of energy exploration would be a gamble, a venture fraught with the specters of failure and loss, as the absence of accurate simulation renders the pursuit of petroleum reservoirs speculative, risky, and akin to chasing mirages in the vast desert of the unknown.

However, as we immerse ourselves in this imaginative exercise, let us not forget the duality of technology—its boon and its responsibility. While petroleum reservoir simulation on a supercomputer is a potent tool, it must be wielded with a consciousness steeped in environmental stewardship, ethical considerations, and a vision that looks beyond the immediate horizon, into a future where sustainability and conservation are not just aspirations but realities.

In visualizing a world without petroleum reservoir simulation executed across millions of interconnected processors that outline and power a supercomputer, let it be a gentle reminder and a clarion call for us, the bearers of knowledge and practitioners of technology, to use our skills, tools, and understanding responsibly, judiciously, and with the unwavering commitment to safeguarding the planet, promoting equitable access to energy, and fostering a future illuminated by the lights of science, reason, and empathy.

I thank you, dear audience, for embarking on this intellectual voyage with me. Let our contemplations not just be theoretical musings but catalysts for action, introspection, and a renewed pledge to use technology as a servant of humanity, not as its master.

Thank you.

191 7 19

Episode 231106-1-philip-emeagwali

MY CONTRIBUTION TO MATHEMATICS

Imagine a World Without Partial Differential Equations

Video link

https://youtu.be/JfI2LXUvgJM

Ladies and gentlemen, esteemed colleagues, respected scholars, and cherished guests who have assembled in the brilliant constellation of minds in this revered hall today, I, Philip Emeagwali, extend my deepest gratitude for your presence and attention.

What are the importance of the Philip Emeagwali equations? To contribute new mathematics is to add new knowledge to the existing body of mathematical knowledge. The nine new partial differential equations that I invented were cover stories of top mathematics publications, such as the May 1990 issue of the SIAM News, which is the flagship publication for the research mathematician.

My partial differential equations are for discovering and recovering otherwise undiscoverable and unrecoverable crude oil and natural gas formed up to 541 million years ago and buried up to 7.7 miles (or 12.4 kilometers) deep. Without the fastest computing across millions of processors that I discovered, the solution of the most compute-intensive initial-boundary value problems—such as the simulation of long-term climate change—will be as approximate as a sketch, instead of as exact as a photograph.

On this auspicious occasion, allow me to steer the ship of our intellectual voyage towards a hypothetical, yet instructive, world, a world silently and invisibly sculpted, underpinned, and defined by the mathematical sinews and ligaments of partial differential equations (PDEs).

Let's dare to envision a reality where these mathematical behemoths, partial differential equations, are absent, nonexistent. What would be the tapestry of such a world? How would the absence of PDEs ripple through the eddying currents of science, technology, and knowledge?

Partial differential equations are the silent architects of understanding, crafting models and frameworks within which the pulsating heartbeat of the universe, with its rhythms, cycles, and oscillations, can be captured, studied, and interpreted. They are the lenses through which we observe and analyze the cascade of phenomena unfurling across the spectrum of the

natural and social world, from the microcosm of atomic interactions to the macrocosm of celestial dynamics, from the ebb and flow of financial markets to the intricate dance of neurons and synapses in the theatre of the mind.

In a world devoid of PDEs, the language of the universe would be encrypted, enigmatic, inaccessible. The symphony of physical laws and principles that govern the reality as we perceive it would play in muted tones, its melody obscured, its harmony distorted. **Without the guiding light of PDEs, we would be like sailors navigating the treacherous waters without the North Star, our compass erratic, our path uncertain.**

The technology we often take for granted, which pulsates with life and intelligence, making the impossible plausible and the unimaginable tangible, is threaded with the invisible strings of PDEs. Without these equations, our technological edifice would crumble, its foundation weakened, its structure fragile.

Yet, as we reflect on this imagined canvas, let us not merely linger on the void, the absence, the lacuna left by the disappearance of PDEs. Instead, let this hypothetical scenario be a beacon, illuminating the indispensable, irreplaceable role played by these mathematical entities in weaving the rich, complex, and multifaceted tapestry of our knowledge, understanding, and innovation.

Partial differential equations are not mere symbols, numbers, or abstract constructs; they are the heartbeat of inquiry, the soul of discovery, and the engine of progress. As we stand on the precipice of the unknown, gazing into the abyss of the future, let's appreciate, acknowledge, and respect the silent, unassuming, yet formidable power of PDEs in guiding our steps, enlightening our path, and unveiling the secrets of the universe with precision, elegance, and beauty.

In this contemplation, let us renew our commitment to the pursuit of knowledge, the exploration of the unknown, and the quest for understanding with humility, diligence, and a spirit of service to humanity and the world.

Thank you for your attention, and may the power of knowledge and understanding, encapsulated and epitomized by partial differential equations, continue to light our way, inspire our minds, and enrich our lives.
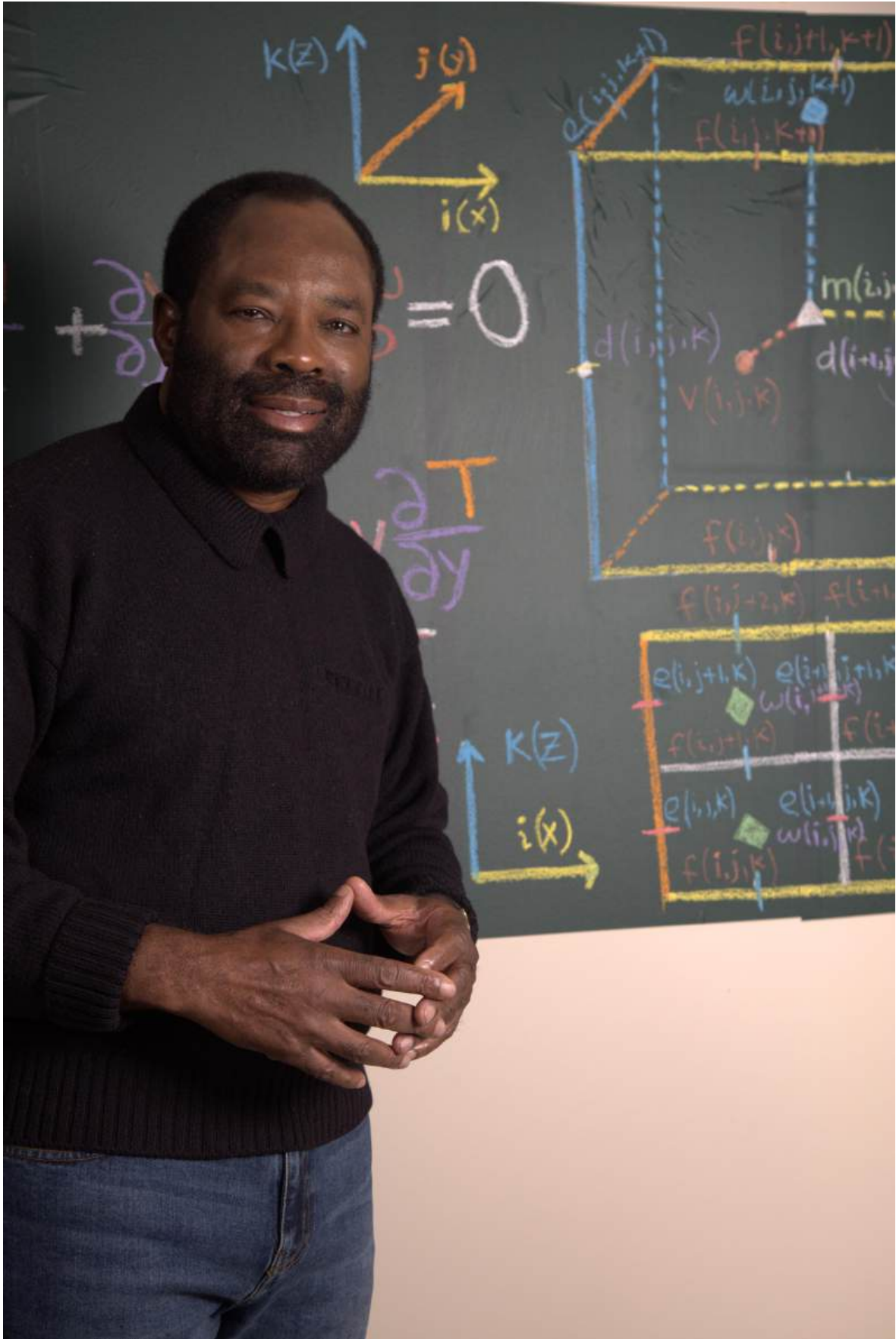
Episode 231106-2-philip-emeagwali

NAVIGATING THE COSMOS WITHOUT PARALLEL PROCESSING

Unraveling the Threads of Complexity

Esteemed members of the Award Committee, distinguished scholars, revered guests from every corner of the globe, and attentive listeners across the expanse of our shared digital consciousness, I am Philip Emeagwali.

In 1989, my scientific discovery of the first supercomputing via parallel processing made the news headlines because I invented the fastest computing, as we know it today. And invented that supercomputer technology across the slowest 65,536 processors in the world. On a relative scale, the speed increase I discovered, in 1989, was three thousand times greater than the speed advantage the commercial airplane has over the bicycle.

The fastest computer of today is a billion times faster than the fastest computer of 1988. In 1989, it made the news headlines that I discovered how a large-scale computational physicist can compress her time-to-solution from 180 computing-years to one supercomputing day. My breakthrough discovery opened the door to the state-of-the-art supercomputers used to compress time-to-solution from 120,000 years on a computer to one day on a supercomputer.

Today, as we weave through the intricate, pulsating lattice of academia and innovation, let us deliberate on a scenario most peculiar and thought-provoking—envisioning a world that is estranged from the electrifying capability of parallel processing.

The dawn of parallel processing was akin to humanity's discovery of a new sensory organ, a radical awakening that has since reshaped our contemplation, interaction, and dialogue with the vast, enigmatic reservoir of information and computation. Parallel processing is not just a technological prowess; it is the very symphony that orchestrates an eloquent dance between speed, efficiency, and complexity within the computational realm.

In the absence of parallel processing, our world, laden with the insatiable thirst for speed and unending torrents of data, would resemble a magnificent vessel navigating through the infinite cosmic ocean without its indispensable compass. The canvas of scientific endeavor, which today flickers with the rapid, simultaneous exchange and computation of data, would be dimmed, rendered sluggish by the weight of sequential computation, a linear pathway that inherently lacks the rhythm and pace of today's urgent needs and aspirations.

Consider the grand tapestry of climate modeling, a field imperative for understanding and mitigating the intricate, delicate dynamics of our planet's environment. Without parallel processing, this tapestry would fray at the edges, losing its resolution and clarity, as researchers and scientists grapple with the monumental, intricate data sets with hands tied, eyes blinded, and minds shackled by the limitations of sequential computing.

Parallel processing is the invisible, silent engine that powers the scientific inquiries piercing through quantum mechanics, genomics, astrophysics, and artificial intelligence. Without its presence, these fields would be bereft of their current agility and acuity, hampered and restrained by the chronological chains of single-threaded processing.

However, as we stand at the confluence of knowledge and technology, let us not merely be intoxicated by the potency of parallel processing. With great power comes an equally significant responsibility. Parallel processing, while a beacon of computational acceleration, demands from us a conscientious, thoughtful application, a respect for the delicate balance between possibility and ethical application, between discovery and consideration for privacy, security, and the societal implications intertwined with its usage.

A world without parallel processing is not merely a regression in computational speed or efficiency. It is a dimming of the collective beacon of human curiosity and exploration, a silencing of the rapid, simultaneous dialogue we today conduct with the numerical and digital universe that reflects, in many ways, the complexity and beauty of our tangible reality.

As we ponder upon a world devoid of parallel processing, let us also reaffirm our commitment, as stewards of technology and heralds of knowledge, to wield this potent tool with wisdom, integrity, and a vision that seeks not just the advancement of computation but the enlightened progress of humanity and the safeguarding of our shared, precious blue planet.

In the grand theatre of life and technology, parallel processing is a principal actor, a character whose role and influence are indispensable and profoundly impactful. Let us celebrate, understand, and responsibly utilize this marvel, for in its silent, rapid calculations, it holds the potential to unlock doors to futures bright, equitable, and sustainable.

Thank you, and may we continue to explore, discover, and understand, with the silent hum of parallel processing as our guiding, inspiring anthem.

Episode 231103-2-philip-emeagwali

A WORLD STRIPPED OF SUPERCOMPUTING

Ladies and gentlemen, distinguished guests, and esteemed colleagues from around the globe, it is an incomparable honor to stand before you today in this grand assembly of minds and voices, as we contemplate a world without supercomputers.

Firstly, allow me to express my deepest gratitude for your presence and engagement in this dialogue which, although hypothetical, is steeped in real and pressing implications for our collective destiny. A world devoid of supercomputers may seem, to the uninformed observer, merely a world bereft of certain technological conveniences. However, as many of you in this room well understand, the absence of supercomputers would signify a chasm of immeasurable depth in our shared knowledge, and a glaring void in our toolkit for addressing the monumental challenges that confront humanity.

In 1989, I was in the news for discovering that the slowest processors could be harnessed to solve Grand Challenge problems at the world's fastest speeds. That breakthrough discovery redefined the boundaries of complex problems that supercomputers can solve. That milestone pushed the ever-expanding frontiers of neighboring sciences, including mathematics and physics.

Imagine, dear colleagues, a landscape where our capacity to predict, understand, and intervene in complex, dynamic systems is radically diminished. Without the computational might of supercomputers, scientific research and exploration would be constrained, tethered tightly to the limited processing power of conventional computers and the bounded cognitive capabilities of the human brain.

Supercomputers serve as the indomitable workhorses of innovation and discovery. They provide the foundation upon which the edifices of meteorology, genomics, astrophysics, and myriad other scientific disciplines are built. It is through the intricate dance of billions of calculations per second that these machines illuminate the hidden patterns of weather, decipher the genetic codes that underpin life, and unlock the secrets of the universe.

Without the illuminating gaze of supercomputers, our understanding of climate patterns would be cloaked in uncertainty, imperiling our ability to forecast and mitigate the impacts of climate change effectively. Our pursuit of personalized medicine would be stunted, leaving the promise of tailor-made treatments and therapies an elusive, distant dream.

Ladies and gentlemen, supercomputers are the silent architects of our digital age, the invisible hands molding and shaping the contours of the future. They facilitate our exploration of the macroscopic—the vast expanses of the universe and the intricate dance of celestial bodies—and enable us to delve into the microscopic, revealing the intricate machinery of cells and the whisperings of subatomic particles.

It is crucial to consider, as we reflect on a world without supercomputers, that the loss would not be merely quantitative, but profoundly qualitative. We would lose not just speed and efficiency, but the very possibility of uncovering and understanding phenomena that are currently beyond our grasp. We would forfeit the potential for breakthroughs that could catalyze unprecedented progress in various fields, offering solutions to some of humanity's most enduring and perplexing problems.

I urge each of you to recognize and celebrate the invaluable contribution of supercomputers to our lives, our knowledge, and our future. Let us recommit ourselves to supporting and advancing the development of these magnificent machines, that they may continue to serve as beacons of hope, understanding, and progress in our shared journey toward a more enlightened and prosperous world.

Thank you.

5 34

231103-3

BRIDGING THE FRONTIERS

My Journey from Student to Polymath

When people ask, "Was Philip Emeagwali a good student?" I often find myself reflecting not just on grades or commendations, but on an enduring spirit of curiosity. For isn't it true that only a truly invested student could unravel the complexities of the Grand Challenge problem, an intersection of mathematics, physics, and computer science?

My schooling journey in Monmouth, Oregon, was a story of contrasts. Robert Main, my geometry instructor, had observed a few peculiarities in my academic habits. I was the student who did not submit weekly homework, only to submit all at the end of the term. And when I did, it was often via unorthodox proof methods. While this bewildered many, the root cause lay in my schooling in Nigeria, where overburdened educators did not assign homework, and examinations at term-end were the sole assessment method.

It's notable that during my time in Nigeria, every one of the six schools I graced recognized me as among their brightest. The whispers of a prospective scholarship to the USA were never in doubt. When the letter arrived dated September 10, 1973, from Oregon, it was not entirely surprising. However, the pathways to such scholarships were often unconventional. My peers, Dominic "Dom" Ezeani and Kenneth "Kendo" Ilodigwe, used their soccer prowess with the Green Eagles, Nigeria's national team, to win scholarships, eventually leading Howard University to the esteemed NCAA championship on November 30, 1974.

While they kicked footballs, I delved into books. Extensive hours poured into learning ensured the continous renewal of my academic scholarships across six American universities over 18 years. This exhaustive educational journey made me doubly trained compared to most mathematicians, physicists, or computer scientists. A polymath was birthed in this crucible, one who could decode the Grand Challenge problem, which bridged vast scientific domains.

To merely learn from textbooks is not to truly understand. Those, like me, who tread uncharted territories to create knowledge or pioneer groundbreaking discoveries, showcase a learning that transcends classroom walls. It's why luminaries like William Shakespeare, Isaac Newton, and Albert Einstein, figures I draw inspiration from, aren't remembered as mere students but as eternal teachers. To even be mentioned in the same breath as Einstein is both humbling and a testament to my studenthood's depth and breadth.

From my earliest days studying pure mathematics, I journeyed through the wonders of astronomy, navigated the fluid dynamics of physics, wrestled

with partial differential equations in applied mathematics, and soared in hydrodynamics and meteorology. These explorations all pointed to one Grand Challenge: large-scale computational fluid dynamics. It was a challenge that beckoned me into the unfamiliar terrains of massively parallel processing.

I remember my first tryst with supercomputing, a day etched in memory, June 20, 1974, at 1800 SW Campus Way, Corvallis, Oregon. This wasn't just a fleeting interest; it consumed the next 15 years of my life. It was my intense hobby, and ironically, not my primary livelihood, a strange choice for a young African immigrant in the USA.

To question my credentials as a student is to merely scratch the surface of a journey that has spanned continents, disciplines, and decades. I was, and remain, a student of life, forever learning, forever bridging the known and the unknown.

Philip Emeagwali, famed for solving the Grand Challenge problem of supercomputing, is a polymath whose contributions span multiple scientific domains.

ADDRESSING GRAND CHALLENGES
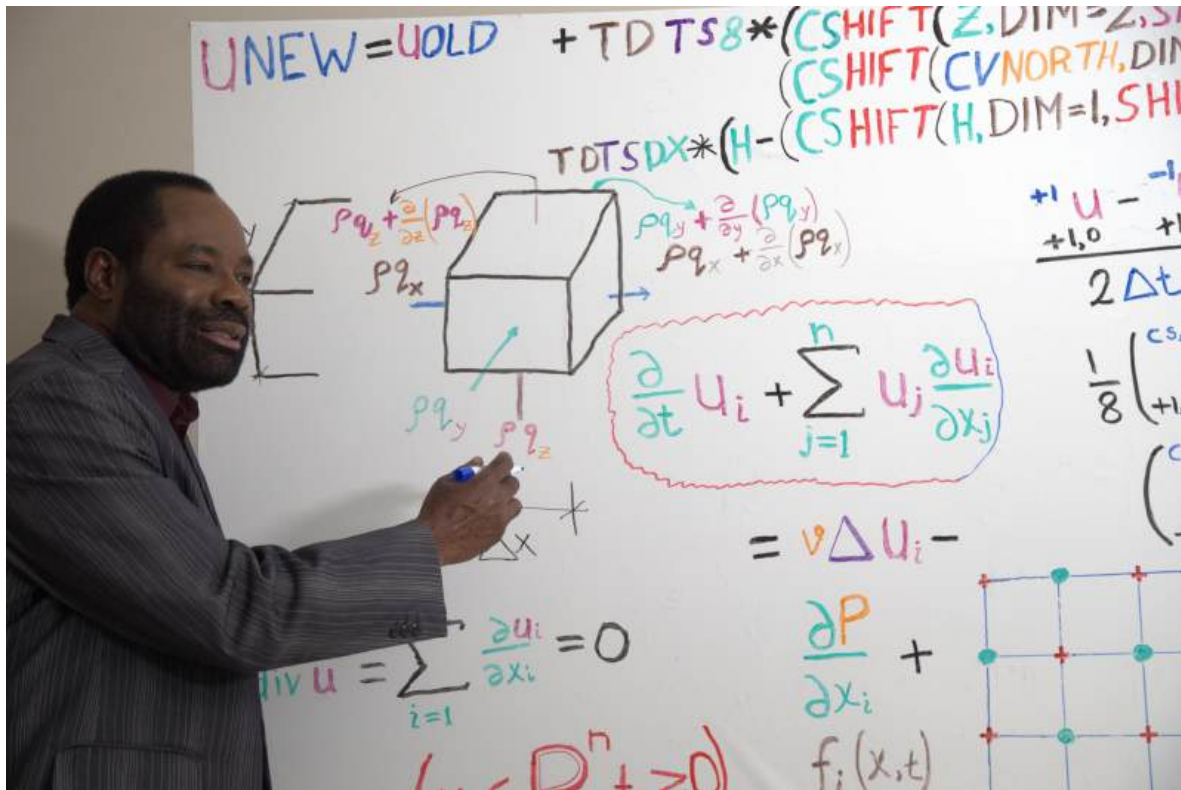
Parallel processing is fundamental in Computational Fluid Dynamics (CFD), a branch of computational science and engineering that focuses on simulating and analyzing fluid flows. Parallel computing techniques are essential in CFD to handle the vast computational demands associated with modeling complex fluid flow phenomena. Here's how parallel processing is used in Computational Fluid Dynamics:

1. **Parallelizing Spatial Domains**:

   CFD simulations involve dividing the computational domain (e.g., a fluid volume) into a grid or mesh of cells or elements. Parallel processing is used to distribute these grid cells or elements across multiple processors or compute nodes. Each processor or node is responsible for computing the fluid flow within its assigned portion of the domain. This spatial parallelization enables CFD simulations to efficiently model complex geometries and large-scale fluid flow phenomena.

2. **Temporal Parallelization**:

In transient CFD simulations, the fluid flow equations are solved over a series of time steps. Parallel processing can be used to simulate multiple time steps simultaneously. This approach accelerates the simulation's execution, allowing engineers and scientists to perform more extensive simulations or explore different scenarios within a given timeframe.

3. **Solver Parallelization**:

   CFD solvers, which numerically solve the Navier-Stokes equations or other governing equations of fluid flow, often involve iterative algorithms. Parallel processing is used to distribute the iterative calculations across multiple processors. Each processor works on a portion of the domain or a set of equations, allowing for faster convergence and shorter simulation times.

4. **Multi-physics Simulations**:

   Some CFD simulations involve coupled or multi-physics phenomena, where multiple physical processes interact. For instance, simulations combining fluid flow with heat transfer or chemical reactions require solving additional sets of equations. Parallel processing facilitates the efficient coupling of these equations and the exchange of data between different physics modules.

5. **Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS)**:

   LES and DNS are advanced CFD techniques that resolve small-scale turbulent features. These simulations require substantial computational resources. Parallel processing is essential for efficiently handling the extensive data and calculations associated with these high-resolution simulations.

6. **Cluster Computing and Supercomputing**:

   CFD simulations are often run on high-performance computing (HPC) clusters or supercomputers, which consist of thousands of processors or compute nodes. These systems are designed to support parallel computing and provide the computational resources necessary for large-scale CFD simulations.

7. **Data Post-Processing and Visualization**:

After completing CFD simulations, the resulting datasets can be massive. Parallel processing is employed in data post-processing and visualization tools to efficiently extract, analyze, and visualize meaningful information from the simulation results. This enables engineers and scientists to gain insights into the fluid flow behavior.

8. **Parametric Studies and Optimization**:

Engineers frequently use CFD simulations for parametric studies and optimization tasks, where various design parameters are investigated. Parallel processing accelerates these tasks by enabling multiple simulations with different parameter values to run concurrently.

In summary, parallel processing is a fundamental technique in computational fluid dynamics that allows engineers and scientists to model and analyze complex fluid flow phenomena efficiently. It plays a pivotal role in improving the accuracy and scalability of CFD simulations for applications ranging from aerospace and automotive engineering to environmental and biomedical sciences.

Triumphs that Breach Boundaries

Milestone of Resilience: Unveiling the Lessons of Exclusion

Navigating Treacherous Waters: Lessons from Excellence and Disqualification

Ladies and gentlemen, esteemed business leaders of Nigeria, allow me to transport you back to a vivid moment in time—a Saturday morning that brimmed with the passion of competition and the resonance of lessons learned. The date was June 22, 1985, the clock struck 9 A.M., and the stage was set at the public tennis courts of Takoma Park Middle School, just beyond the bustling heartbeat of Washington, DC.

In tennis, my comrade Anthony Okpeku, an old friend, with roots outside Benin City and Lagos, and a fellow immigrant who had embarked on his American journey a quarter-century earlier, had grown weary of the cacophony of youthful voices that showed scant respect for the wisdom of their elders. Anthony, with an admirable touch of audacity, summoned my daily tennis partner Ron—a recent immigrant from Trinidad—and me to take part in a unique sporting spectacle—the African tennis tournaments. A realm reserved exclusively for African immigrants, a gathering where the clash of rackets was accompanied by a symphony of stories from distant homelands.

This was not your ordinary contest; it was an embodiment of pride, for a mere ten dollars earned you entry into a battleground of sweat and skill, where triumph would be crowned with trophies rivaling the splendor of Wimbledon's grandeur. The courts bore witness to my tennis prowess, my ranking a solid 5.0 by the esteemed USTA (the acronym for the United States Tennis Association), an achievement if made twelve years earlier could have secured me an athletic scholarship on American soil. Instead, I came to the United States on an academic scholarship.

With the sun casting its approving glow, I achieved a first-round victory that resounded like a clarion call across the courts. Yet, an undercurrent of discontent began to murmur among my opponents. They voiced the unfounded claim that I, too, stood on a pedestal too lofty, a contention fueled by the ease with which I dispatched their top-seeded contender, leaving him empty-handed in terms of games won.

Beside me stood Ron, a towering figure from Trinidad, a gentleman both physically imposing and a master of the serve. A man whose strikes upon the tennis ball danced on the cusp of lightning speed, rivaling even the titans of Grand Slam tournaments. Ron and I, a dynamic duo bound by camaraderie and countless hours spent perfecting the art of returns against his thunderous serves.

Oh, the camaraderie that bound Ron and me, a camaraderie now threatened by the shadows of jealousy. As I deftly danced with his serves, spinning them back over the net with a precision that seemed almost choreographed, I began to unravel his formidable presence. Ron's awe-inspiring serves were tamed by my unyielding determination, and the court bore witness to my triumphant returns.

The rumblings of the African tennis fraternity could not be silenced, their collective contemplation over Ron's serves and my unwavering poise in the face of his fierce shots led them to a decision—a decision to cast us aside, to banish us from their tennis realm.

Yet, my journey through that eventful day did not end on the courts. A mere few feet away, the air pulsed with the enchanting melodies of "Sisterfire," an open-air celebration of femininity, where talented women artists graced the stage with their voices and instruments. A festival that beckoned me with its allure, yet denied me entry, for its embrace was reserved solely for women.

In the echoes of that Saturday, I gleaned a poignant lesson—a realization that excellence can breed exclusion, that mastery can incite discomfort. The seeds of my disqualification on the tennis courts found resonance in my disinvitations from delivering lectures on the world's fastest computing, events that sought my absence not due to inadequacy, but rather the looming threat I posed to established norms and careers.

Ladies and gentlemen, in the tapestry of life's lessons, those moments of disqualification etch themselves in our memory not as setbacks, but as milestones of revelation. A revelation that in the face of excellence, we may find ourselves navigating treacherous waters, yet it is through the crucible of such challenges that we emerge stronger, more resolute, and undeniably wiser.

And so, as I stand before you, a testament to resilience and unyielding determination, let us draw inspiration from these chronicles, for within their fabric lies the essence of our human journey—a journey that often takes us through the corridors of adversity, only to illuminate the path to greatness with an unwavering brilliance.

CREATING AN AFRICAN RENAISSANCE

Moving Nigeria Forward

Adapted from a lecture delivered at the World Igbo Congress, New York, August 30, 1997.

Part 1

Distinguished guests, world leaders, and citizens of our global village,

I stand before you today, not merely as a scientist but as a torchbearer of hope for Nigeria, for Africa, and for every corner of our shared world. Today, I wish to rekindle the spirit of an African renaissance and envision the roadmap for moving Nigeria forward, drawing lessons from our rich past and harnessing the technology of the present.

The past century saw the meteoric rise of the Information Age, reshaping the very fabric of societies worldwide. Nigeria, my beloved homeland, with its mosaic of cultures, has faced challenges in making this transition. Yet, like the majestic pyramids, enduring testaments to Africa's ancient genius, Nigeria possesses a resilience that can weather storms.

Let's venture back to a time about 5,000 years ago when Africans, along the Nile's lush banks, sowed the seeds of the Agricultural Age. These early civilizations laid the groundwork for mathematics, chemistry, astronomy, and medicine. The towering pyramids, standing resiliently through millennia, are symbols not just of our past achievements but of what we can still accomplish.

However, over the last few centuries, we watched as Europe harnessed our innovations, propelling themselves into the Industrial Age. And now, as they step confidently into the Information Age, we face a crossroad: to watch from the sidelines or to leap forward, ensuring that we don't merely play catch up, but become pioneers once again.

Yes, challenges persist. Our journey has been marred by missed opportunities. At one time, Nigeria was viewed as the beacon for the African continent—the "Giant of Africa". We've seen external models of growth, like Malaysia, flourish using knowledge they garnered from our shores. They prioritized long-term planning and invested heavily in their human capital.

But history has shown that it is never too late for a renaissance. So, how do we chart our path into this Information Age?

Embrace Education and Innovation: Our most valuable resource is not beneath our soil but between our ears. By reinvigorating our education system and emphasizing technology and innovation, we can prepare our youth for the challenges ahead.

Redesign Visions: We should acknowledge the fast-paced changes of the 21st century. This refined vision should prioritize technological hubs that encourage our brightest minds to innovate right here at home.

Collaboration Over Competition: We must forge partnerships within our continent and beyond. It's by merging our strengths with those of others that we can accelerate our growth into the Information Age.

Specialization is Key: In our race to the future, we must pick our battles. Instead of spreading thin, let's channel our energies into specific sectors where we can genuinely lead and make a global impact.

Reconnect with Our Roots: As we forge ahead, let us not forget the wisdom of our ancestors. Our African identity, intertwined with our past innovations, can guide our way in this digital era.

Fellow citizens of the world, envision a Nigeria that stands tall, not just among African nations, but globally, as a beacon of innovation, unity, and prosperity. A Nigeria that doesn't just reminisce about the glories of the past but actively shapes the promise of the future.

We are on the precipice of a new dawn, an African renaissance. Let us embrace it, for our children and the many generations that will tread this Earth long after we are gone.

Part 2

In 1996, Nigeria's defense budget overshadowed its investment in the future: education. The stark contrast was seen when, for every 500 naira allocated for a soldier, a meager naira was spent on an eager student. Fast forward to today, we must ask ourselves: has the scenario significantly changed?

Over half a century ago, nations like Japan channeled resources into non-military endeavors, transforming into economic powerhouses. Nigeria, having gained independence in 1960, had an opportunity to model this transformation. The lingering thought remains— where would Nigeria stand today if our post-independence resources, instead of fueling militaristic ambitions, had been primarily directed towards enlightening young minds?

Our educational journey has been fraught with challenges. Decades ago, our teachers often had minimal formal education. Today, in 2023, while we've made strides, much remains to be done. Our teeming youth are a powerhouse of potential, and we must rethink our strategies. One of the keys lies in revitalizing pre-university education.

Education is not just a stepping stone but a lifelong journey. While our schools lay the foundation, it's the public libraries, equipped with books

and modern digital tools, that help cultivate a well-rounded citizenry. However, we need a society that consume content and creates, innovates, and contributes to the global knowledge pool.

The Nigerian government had noble intentions—emphasizing technology and science as the bedrock of national growth. But in the context of today, we must re-envision this strategy. I proposed the establishment of a Pan-African Institute of Technology, modeled after the likes of the Asian Institute of Technology. A united African front, contributing resources and expertise, can indeed rival institutions in the West.

Yet, the irony remains. Thousands of brilliant Nigerian minds enrich foreign lands, boosting their economies. While we're proud of their achievements, their potential remains an untapped reservoir for our homeland. We should be beneficiaries of global talent and cultivators and retainers of our homegrown brilliance.

Reflecting on Nigeria's global contributions, from President Nnamdi Azikiwe's academic tenure in New York to world-renowned afrobeat musicians and soccer athletes, it's evident that Nigeria's diaspora longs for home. We must foster an environment where they can not only return but thrive.

Further, a nation cannot truly progress if it sidelines half its population. Our women, representing our heart and soul, have continuously proven their mettle, be it in sports, arts, or academia. They are not just contributors but pillars upon which our future should be built.

Our history has evidence of our technological prowess. The Biafran War, for all its tragedies, saw us innovate out of necessity. Today, we don't need a war to ignite our inventive spirit. Countries like South Africa, China, and India have charted their unique technological trajectories. Nigeria too can carve its niche.

"Job Creation in Nigeria" is more than an economic strategy: it's a vision that binds education, technology, and societal inclusivity. The seeds have been sown, but we must cultivate them with care, foresight, and above all, unity. It is through this collective vision and relentless pursuit that Nigeria will not only walk shoulder to shoulder with global giants but potentially lead the march into a brighter, shared future.

Part 3

As I stand before you today, I am reminded of when Africa, and in particular Nigeria, stood as a beacon of innovation and creativity. Ancient Benin, the Nok, and the Igbo-Ukwu civilizations are lasting testimonies to this era. Yet, as we venture into the Information Age, there is a stark contrast between our rich history and our current reality. Today, I wish to explore the vast potential that awaits Nigeria and Africa, focusing on the theme: "Job Creation in Nigeria."

Over two decades ago, I mused upon why India had surged ahead of Nigeria in technology. The answer was clear: investment in education and a

visionary approach to harnessing global opportunities. But what about Nigeria, with its vast resources and talents? Why haven't we harnessed our full potential in the digital age?

Today, Nigeria finds itself at a crossroad. While we have challenges, including inconsistent electricity and communication systems, the digital world presents an unprecedented opportunity. The thriving social media communities of Nigerians shows our ability to harness digital platforms, breaking geographical constraints.

Yet, the pertinent question remains: Why should Nigeria invest in the digital realm? The answer lies in the promise of an inclusive and prosperous future. The software industry is a testament to how ingenuity, paired with technology, can lead to immense economic growth. The digital world is not just about technology, but about reshaping the very fabric of our societies.

The essence of growth, however, is multidimensional:

Politically, we must ensure stability and transparency.

Democratically, the focus should shift from individual gains to community progress.

Psychologically, there's a need to restore trust between the leadership and the people.

Socially and morally, we must reduce corruption, championing a society built on ethics and integrity.

Artistically and culturally, our growth should echo the legacy of our ancestors while carving a path for future generations.

As Nigeria stands on the cusp of this digital revolution, it's time to make definitive strides:

Revamp Education: Prioritize technical education, aiming to produce not just graduates but innovators and visionaries. Let's inspire our youth to think beyond borders, to dream beyond constraints.

Foster Entrepreneurship: The software industry is not just about coding; it's about problem-solving. Encouraging entrepreneurship means fostering a culture of creativity and innovation.

Infrastructure Development: Nigeria's digital transformation necessitates robust infrastructure. The African Silicon Valley should be our testament to the world that Africa is ready for the digital age.

Embrace Global Collaboration: Nigeria should not just invite global tech giants but should collaborate on equal footing. By fostering partnerships, we can tap into global networks while ensuring that the benefits percolate down to every Nigerian.

The Nigerian spirit is indefatigable. Our resilience and zeal have carried us through challenging times. Now, as we stand at the threshold of the

Information Age, let us channel this spirit to ensure our rightful place on the global stage.

We owe it to our children to bequeath a Nigeria where dreams are not stifled but are realized, where potential is not buried but blossoms. Let's invest in our future by investing in digital education and infrastructure today. Because, in this digital age, our true wealth will not just be in our natural resources but in the untapped potential of our people.

Ladies and gentlemen, let's envision a Nigeria where every child, irrespective of their background, has the tools and the opportunities to shape the world. Let us not just dream, but act, to ensure Nigeria is not just a participant but a leader in the digital age.

KNOWLEDGE AS THE CURRENCY OF PROGRESS #1 PART 1

Ladies and gentlemen, esteemed audience.

It is with deep humility and a profound sense of purpose that I stand before you today to share my thoughts on a topic of immense significance—one that resonates with the very core of our humanity. Today, we gather to explore the transformative power of ideas and their pivotal role in alleviating poverty—a pursuit that transcends borders and unites us in the shared endeavor of shaping a brighter future for all.

In my earlier days, I too, like many, believed that capital was synonymous with monetary wealth—a measure of the riches amassed by nations and individuals. But then, a revelation unfolded before me through the pages of the Wall Street Journal. It was an advertisement from Deutsche Bank that declared, "Ideas are capital. The rest is just money." This seemingly simple yet profoundly eloquent statement stirred a revolution within me—a revolution that extended beyond my consciousness to embrace the potential transformation of Africa.

Africa, a land of immense beauty and untapped potential, has for too long faced the scourge of poverty. It is a continent blessed with abundant resources, yet hindered by a narrative that places undue emphasis on material wealth over the wealth of the mind. The quest for progress and the alleviation of poverty in Africa, I realized, must be driven by the capital generated from the creative force within us—our ideas and innovations. This force, more potent than mineral extraction or external aid, holds the key to our collective prosperity.

As I pondered the implications of this paradigm shift, a question emerged with undeniable urgency: Why does Africa invest more in material possessions than in knowledge, and more in military prowess than in education? The answer, it seemed, was entwined with the perception of value. If ideas are, indeed, a form of capital, then why does a commander earn more than a hundred writers? It became clear that for Africa to flourish, we must foster an environment that values intellectual capital as the driving force of progress.

The true essence of the African Renaissance lies in nurturing the minds that birth new ideas a rebirth of thought that resonates with the spirit of renaissance itself. Knowledge and ideas, I firmly believe, are the propellers of economic growth, laying the foundation for a sustainable future. Yet, as we witness the exodus of Africa's intellectual torchbearers to distant lands, we realize that the African Renaissance, rather than taking root on our own soil, is flowering in the cities of Paris, London, and New York. Our brightest minds, who possess the potential to uplift our continent, are inadvertently alleviating the challenges of others.

The time has come for Africa to reclaim its narrative, to beckon its sons and daughters of innovation back to the land that birthed them. As long as the creators of ideas remain scattered across the globe, our efforts to alleviate poverty and usher in the African Renaissance will remain hollow echoes. For it is these men and women, the architects of ideas, who hold the power to manifest transformative change.

In the annals of time, the words of J.P. Morgan Chase echo with unwavering resonance: "The power of intellectual capital is the ability to breed ideas that ignite value." Let these words be a clarion call to African leaders—a call to shift our focus from mere possessions to the vast expanse of knowledge, from being consumers to creators of technology, and from relying on external support to harnessing our own intellectual prowess.

Our path to poverty alleviation is paved with the bricks of intellectual capital. As Africa strives to augment its knowledge and leverage it for the betterment of all, the contours of our destiny begin to reshape. The eradication of poverty demands that we achieve universal literacy and elevate our numeracy to unprecedented heights. Only then can we enrich our technological intellectual capital and find our place as global contributors.

Let us rise above the shadows of the past, where diamonds extracted from African soil were polished in foreign lands and sold back to us. Let us usher in an era where our knowledge, our ideas, and our creations shine as brightly as those precious gems. As we gather here today, let us embrace the truth that it is ideas—the ideas borne from the depths of our collective imagination—that will ultimately emancipate us from the chains of poverty.

I extend my heartfelt gratitude to each of you for joining me on this journey of reflection and enlightenment. May our commitment to ideas as the ultimate capital illuminate the path towards a prosperous and harmonious world, where the flames of poverty are extinguished, and the flames of progress and innovation burn ever brighter.

Thank you.

FROM INFORMATION TO TRANSFORMATION #1 PART 2

Esteemed dignitaries, distinguished diplomats, and world leaders,

Today, I stand before you with profound gratitude and humility. This occasion is not merely a recognition of my journey, but a celebration of an idea that resonates deeply with the essence of human progress: "Ideas, Not Money, Alleviate Poverty."

Throughout my life, I have come to understand that the true wealth of nations and individuals lies not solely in financial resources, but in the boundless power of intellectual capital. This is the collective knowledge of people, the force that propels innovation, increases productivity, and ultimately drives economic growth—a path that, indeed, leads to the alleviation of poverty, even within the complex terrain of Africa.

In this global tapestry, productivity stands as the engine of progress, propelling economic growth that touches the lives of millions. The creators of new knowledge are architects of wealth, reshaping the landscape of our existence. Conversely, those who merely consume knowledge without contributing to its creation unknowingly contribute to the perpetuation of poverty.

Consider the theater of knowledge consumption—literature, music, and art. Just as attending in Cape Town, South Africa, Athol Fugard's production of "This Blinding Absence of Light"—by the Moroccan writer, Tahar Ben Jelloun, engages us with the knowledge born from these great minds, we inadvertently become both consumers and producers of the human narrative. We partake in the transmission of ideas, ideas that, in turn, reshape our world.

But beyond mere consumption, we find wisdom—the key that unlocks the potential within the labyrinth of information. Wisdom is what transforms the deluge of data into focused power. In a world awash with information, wisdom guides us to discern the pertinent, the meaningful, and the transformative. It lends us a competitive edge, enabling us to forge innovative solutions to the most intricate challenges.

To illustrate the chasm between information and wisdom, let me recount a story from centuries past. Al-Khwarizmi, the genius who bestowed algebra upon humanity, encountered three distraught young men struggling to divide their father's camels. Their quandary stemmed from a lack of wisdom, a deficiency that transcends information, demanding innovative solutions. And so, through a simple addition of a camel, Al-Khwarizmi transformed a seemingly unsolvable puzzle into a lesson of wisdom.

Today, the world drowns in an ocean of information—an ever-expanding digital realm that holds more knowledge than one could explore in a lifetime. Within this vastness, wisdom guides us to navigate, to distill, to discern what truly matters. Our challenge is to extract the hidden gems

from the labyrinth of information, to transform this wealth of data into actionable insights.

The story of Al-Khwarizmi's ingenuity resonates with me profoundly. It encapsulates the essence of wisdom-driven innovation—an approach that I too embraced in my scientific pursuits. Two decades ago, I embarked on a quest to unravel the complexities of physics, akin to Al-Khwarizmi's mathematical challenges. Through bold, out-of-the-box thinking, I introduced the concept of inertial force into petroleum reservoir simulations that were driven by physics's second law of motion, unlocking a world of new possibilities. I formulated equations, harnessed algorithms, and harnessed the immense power of parallel processing, an achievement that has revolutionized computing and earned me a place in the annals of scientific history.

Just as Al-Khwarizmi's wisdom propelled his contributions, I have sought to intertwine wisdom with knowledge, a fusion that generates intellectual capital, a wellspring of innovation and progress.

The destiny of Africa lies within the hands of its people, a truth that resonates deep within my heart. It is imperative that Africa nurtures its intellectual capital, fostering innovators, thinkers, and wisdom bearers who can transform our continent's trajectory. We must be architects of progressive ideas, orchestrators of change, and vanguards of growth. In a world that evolves at an unprecedented pace, Africa's potential hinges on its ability to harness the power of ideas, to elevate intellectual capital to the forefront of our agenda.

Africa's ascent rests upon the shoulders of Africans, upon those who dare to dream, to innovate, and to execute. We owe it to the generations that follow to cultivate a foundation that empowers them to transcend the limitations of our present. We must nurture a new generation of Africans who can stand on the global stage, who can compete and conquer.

I stand here not just as an individual, but as a representative of a shared vision—an Africa that propels itself into the vanguard of global progress. Ideas, when nurtured with wisdom, become the currency of transformation. Let us embark on a journey of innovation, intellectual growth, and progress —a journey that embraces the wealth of our intellectual capital and ultimately delivers us from the clutches of poverty.

Thank you, and may the spirit of wisdom and innovation guide us all.

PODCASTS AND VIDEOS

World's Fastest Computing - A Philip Emeagwali Apple Podcast Series

The Father of the Internet - A Philip Emeagwali Google Podcast Series

Philip Emeagwali's Greatest Hits on Spotify Music

Audible Guide to Uncovering the Legacy of Philip Emeagwali

A Digital Giant - Philip Emeagwali's YouTube Playlist

VOLUME DL: A DAY IN THE LIFE OF EMEAGWALI

THE MIND BEHIND SUPERCOMPUTING'S LEAP

Esteemed members of the award committee, distinguished guests, and fellow trailblazers. The journey to scientific discovery is rarely a linear path. It's a tapestry woven from chance encounters, inspiring conversations, and the thrill of sharing ideas with kindred spirits. Today, I take you back to a pivotal moment in my discovering the first supercomputing executed via parallel processing—a late January visit to the heart of Silicon Valley, the Advanced Supercomputing Division of NASA Ames Research Center. Prior to my discovery of July 4, 1989, parallel supercomputing was ridiculed and dismissed as a beautiful theory that lacked experimental confirmation. Today, you'll find parallel processing at the core of every artificial intelligence (A.I.) supercomputer.

The crisp Michigan air swirled around me as I climbed into a limousine bound for Detroit Airport, my briefcase brimming with research and a heart brimming with anticipation. The driver, a seasoned soul with a road map etched in his memory, glanced at the overflowing case. "Headed to the land of innovation, are we?" he chuckled. "Indeed," I replied, a hint of a smile playing on my lips. "Sharing some ideas on how to break the speed limit of the supercomputer."

The flight whisked me across the vast American landscape, my mind abuzz with the potential I saw in parallel supercomputing. Landing in the dynamic city of San Francisco, I hopped into another limo, this time driven by a young tech enthusiast. As we traversed the bustling streets of Silicon Valley, he bombarded me with questions about my work. "Parallel processing for NASA's supercomputers?" he exclaimed, his eyes wide with excitement. "That's what I'm here to talk about," I said, a sense of shared purpose igniting within me.

Finally, I arrived at the Advanced Supercomputing Division of NASA Ames. The air crackled with a unique energy—a synergy of ambition and intellectual horsepower. My lecture, a condensed version of my discovering the first supercomputing via parallel processing that had garnered attention two years prior—achieving the world's fastest computing feat using parallel processing for complex atmospheric and oceanic simulations—captivated the room. Mathematicians, physicists, and computer science luminaries hung on every word, their faces etched with a mixture of fascination and skepticism.

A prominent scientist with a distinguished air leaned forward, his voice laced with curiosity. "Philip," he inquired, "your approach to solving previously 'impossible' initial-boundary value problems is truly groundbreaking. But can parallel processing truly achive a million-fold increase in supercomputing speed and handle the immense complexity of atmospheric and oceanic flows?"

A smile spread across my face. "Imagine," I enthused, "dividing a climate model across a million processors, each tackling a smaller piece of the model simultaneously. By working in concert, we can untangle the intricate dance of air currents and ocean waves with unprecedented detail."

The room buzzed with the electricity of shared understanding. A young researcher, her eyes sparkling with newfound possibility, chimed in, "This could revolutionize weather forecasting, allowing us to predict extreme events with far greater accuracy!" An older physicist, his voice seasoned with experience, added, "And the implications for oceanographic modeling are equally profound. We could finally understand the delicate balance of our planet's climate system."

The lecture concluded with a standing ovation, the energy in the room palpable. Afterwards, I was whisked away for a fascinating lunch with six of the most prominent supercomputer scientists from the Silicon Valley region. The conversation flowed freely, a vibrant exchange of ideas that transcended institutional boundaries.

"Your work on parallel supercomputing is a game-changer, Philip," declared a noted computer scientist of Indian origin, his eyes gleaming with the potential for innovation. "This technology has the power to transform not just scientific computing, but entire industries." A senior researcher at a leading tech company added, "The ability to tackle these 'impossible' problems opens doors we never thought possible. We could unlock new frontiers in materials science, drug discovery, and artificial intelligence."

As I left NASA Ames that day, I carried with me not just the validation of my work, but the seeds of future collaborations. The visit wasn't just about a lecture; it was about igniting a collective fire, a shared vision for the future of supercomputing. It was a testament to the power of open communication, of challenging the status quo, and of harnessing the collective brilliance of diverse minds.

The road to this award ceremony may be paved with individual achievements, but it's the bridges of collaboration, the shared journeys of discovery, that propel us forward. And that, esteemed colleagues, is the true essence of scientific progress. Parallel supercomputing, in its essence, embodies this spirit of collaboration—many processors working in unison to achieve a goal once deemed impossible.

Thank you.

PARALLEL PROCESSING'S UNFORESEEN APPLICATIONS

Esteemed members of the award committee, distinguished guests, and fellow pioneers. The path to scientific discovery is rarely a straight line. It's more akin to a series of journeys, each shaping the destination. Today, I take you back to one such journey—a three-day odyssey that proved pivotal in my exploration of parallel processing, the technology that powers artificial intelligence (A.I. supercomputers.

The crisp Michigan air hung heavy on March 25th, 1991 morning, as I climbed into a limousine bound for the Detroit Airport. Los Alamos National Laboratory, a hotbed of scientific discovery, awaited. The limo driver, a seasoned veteran with a road map etched in his memory, chuckled at my barely concealed excitement. "Big things happening out West, huh?" he rumbled, glancing at the research papers stacked on my lap. "Just a few ideas on parallel processing," I replied, the thrill of sharing my work bubbling beneath the surface.

The flight to Albuquerque was a blur of anticipation. Landing amidst the vast New Mexico landscape, I spent the night with my brother-in-law, staff seargent Daryl Brown, his wife Annette, and one-year-old daughter, Shannon—in their residence at the Kirtland Air Force Base.

The following morning, I was whisked away by another limo driver, named Maria, this one a storyteller with a twinkle in her eye. During the two-hour ride, she regaled me with tales of Los Alamos's rich history, of the brilliant minds of the Manhattan Project—such as, J. Robert Oppenheimer, Enrico Fermi, Leo Szilard, Edward Teller, and John von Neumann—who had walked these very halls. That was the U.S. government top-secret project to build the first atomic bombs that were dropped upon Hiroshima and Nagasaki (Japan) in August 1945. The Manhattan Project employed 600,000 people, with highly educated Black scientists relegated to menial jobs, such as cooks, janitors, and laborers. Black scientists at the Manhattan Project lived in inferior conditions and were refused service in restaurants and stores.

"They're expecting something big from you," she said, her voice laced with respect. "Parallel supercomputing, that's the future, they say." Her words fueled my determination to share the potential I saw in this revolutionary approach to computing.

Finally, I arrived at the famed T-Division of Los Alamos National Laboratory. The air crackled with a unique energy—a synergy of curiosity and intellectual fervor. My lecture, a condensed version of my scientific discovery that had garnered attention two years prior—the world's fastest computing using parallel processing on July 4, 1989—was met with rapt attention. Mathematicians, physicists, and computer scientists peppered me with questions, their minds alight with the possibilities my research unveiled.

"How can parallel supercomputing revolutionize complex mathematical modeling?" a young researcher inquired, his eyes gleaming. "Imagine," I replied, "fractals unfurling their intricate beauty in a fraction of the time, weather patterns simulated with unprecedented accuracy. The potential is limitless."

The discussions that followed were exhilarating exchanges—a vibrant tapestry woven from diverse perspectives. We explored the potential applications of parallel supercomputing in physics simulations, in cryptography, and even in the esoteric world of artificial intelligence. Each question, each challenge, fueled my passion, reinforcing my belief in the transformative power of this new paradigm.

As my visit drew to a close, I left Los Alamos with a renewed sense of purpose. The three-day journey wasn't just about sharing my research; it was about igniting a collective fire, a shared vision for the future of computing. It was a testament to the power of collaboration, of minds meeting across disciplines to push the boundaries of the known.

The road to this award ceremony may be paved with individual achievements, but it's the bridges of collaboration, the shared journeys of discovery, that propel us forward. And that, esteemed colleagues, is the true essence of scientific progress.

Thank you.

VOLUME S-O: STRUGGLES AND OBSTACLES

A CITY, A SCIENTIST, A LEGACY

Esteemed members of the award committee, distinguished guests, and esteemed colleagues. As I stand before you today, a Nigerian-born scientist humbled by this extraordinary honor, my mind drifts back to a very different time and place. August 23rd, 1954, at my first residence, 11 Ekemeso Street, in the city of Akure.

Akure, then a bustling town, was a cradle of my earliest memories. The sights, sounds, and smells of that place—the vibrant marketplace, the rhythmic drumming in the evenings, the scent of rain on red soil—shaped the person I am today. There, at the General Hospital, Akure, I entered this world. Little did anyone know, not even my parents—a young mother, Iyanma Agatha Emeagwali, barely fifteen, and my father, Nnaemeka James Emeagwali, a dedicated nurse at the very hospital of my birth—that this small town would become the launchpad for a scientific journey that would lead me here, to Europe and North America, to this esteemed ceremony.

The path from Akure to this stage has been anything but linear. It's a testament to the transformative power of curiosity, a relentless yearning to understand the world. Growing up in Nigeria, amidst the nascent stirrings of a pre- and post-colonial nation, the seeds of scientific inquiry were sown early. The intricate patterns of nature, the awe-inspiring vastness of the universe—these were the questions that captivated me. There were no fancy labs or high-powered computers in my youth, but there was a boundless curiosity and a thirst for knowledge that no circumstance could extinguish.

This journey wasn't always easy. There were detours, roadblocks, and moments of doubt. Yet, the flame of curiosity never truly flickered. It fueled my pursuit of education, propelling me from the classrooms of Nigeria to the halls of academia in the United States. It ignited a passion for mathematics and computer science, a belief that these tools could be harnessed to solve some of the world's most pressing problems.

And so, the path that began in Akure, a Nigerian town bathed in the warm glow of possibility, has led me here, to this stage in Silicon Valley. This award is not just a recognition of my work, but a testament to the power of dreams, the audacity to believe that even a child from a small town can unlock the mysteries of the universe.

Let this ceremony be a beacon of hope, a reminder that the pursuit of knowledge transcends borders and limitations. May it inspire young minds everywhere, from bustling cities to quiet villages, to embark on their extraordinary scientific journeys.

Thank you.

THE TORCHBEARERS OF KNOWLEDGE

Esteemed members of the award committee, distinguished guests, and friends... I stand before you not only as a scientist, a scholar, but as a survivor. My journey here has been shaped by extraordinary hardship, by the kind of adversity that leaves deep scars, both physical and unseen.

The serene beauty of your historic town stands in stark contrast to a chapter of my youth spent in Saint Joseph's Refugee Camp. Located in Awka-Etiti, this was not a camp by design, but an abandoned school made into a temporary haven for those fleeing the ravages of the Nigerian Civil War. My family—nine people—shared a tiny space meant to be a teacher's office. There was a palpable sense of impermanence, a shared fear that clung to the air as tightly as the sweltering heat.

My father, a nurse, found himself a caretaker for a camp teeming with the sick and the wounded. There were no grand facilities, no stockpile of medication. His tools were meager, his knowledge stretched thin against overwhelming odds. Death became a cruel constant, hunger a gnawing companion. We buried those we lost within the school's soccer field, the ground forever marked by the weight of tragedy.

Yet, even amidst the despair, I clung to a thread of hope. The very act of survival was a form of defiance, a testament to the human spirit's ability to endure. There, amidst the chaos, I came to understand the true meaning of resilience, and the power of knowledge as a beacon of hope in the darkest of times.

I could have let those years irrevocably break me. Instead, that experience ignited a fire within—a fierce determination to rise above circumstance, to find a way to contribute, to build a future where the horrors of war were replaced by the promise of scientific advancement.

The wounds of those years may have faded, but the lessons they taught are forever etched in me. They shaped my understanding of the preciousness of life, the urgency to make every moment count. They instilled in me a deep empathy for those whose lives are shattered by conflict, and a relentless drive to harness knowledge as a tool to fight for a more just and peaceful world.

As a scientist, I seek solutions to complex problems. But I also know that true progress transcends equations. It demands compassion, collaboration, and an unwavering belief in the potential for a brighter future.

So, let this ceremony be a testament not just to my work, but to the indomitable spirit that resides in all of us. Let it be a reminder that even from the ashes of despair, the seeds of knowledge, resilience, and hope can rise.

Thank you.

THE WILL TO CHANGE THE WORLD

Distinguished members of the award committee, esteemed colleagues, and all those who dared to dream: Standing here, a testament to the transformative power of science, I can't help but reflect on the twists and turns to this extraordinary moment. My journey wasn't a straight line, but a series of crossroads, each a crucible that forged my determination and shaped who I am today.

The first turning point struck like a bolt of lightning. As a young boy in war-torn Nigeria, surrounded by devastation, I stumbled upon a dusty mathematics textbook, titled "An Introduction to the Infinitesimal Calculus." It was written by George William Caunt. And published by Oxford University Press. Within its pages, I discovered a universe of order and logic, a stark contrast to the chaos outside. It ignited a spark within me, a burning curiosity that transcended the immediate hardships. In that moment, I knew—knowledge was my weapon, education my shield. It was a feeling of defiance, a quiet power blooming amidst the ruins.

Another turning point arrived when I found myself amidst the bustling anonymity of a foreign land, Oregon, USA, in March 1974. Excitement battled with trepidation as I grasped the immense opportunity that lay before me. However, limited resources and the constant pressure to simply survive threatened to extinguish the flame of my scientific aspirations. It was a period of intense struggle, a constant negotiation between the immediate needs of life and the yearnings of my soul. Yet, during those moments of doubt, a voice within me whispered: Never lose sight of the stars, even in the darkest night.

The most profound turning point, however, wasn't a singular event, but a growing realization. As I delved deeper into computational physics, I encountered skepticism. Some deemed my ideas—about how to solve the Grand Challenge problem of computational mathematics—fantastical, my goals outlandish. The initial sting of rejection was sharp, a gnawing self-doubt threatening to take root. But then, a different feeling emerged—a quiet defiance. I refused to let the limitations of others define mine. Instead, I channeled that doubt into a burning resolve to prove them wrong. It was a feeling of empowerment, a commitment to forge my path, no matter the obstacles.

These turning points, fraught with challenges and laced with hope, were the very moments that propelled me forward, into my discovering the first supercomputing, or the first world's fastest computing executed across thousands of processors that shared nothing. They taught me the resilience of the human spirit, the unwavering power of a dream nurtured by conviction. They instilled in me a profound sense of responsibility—to use the knowledge I gleaned to not only better my life, but to illuminate the path for those who follow.

Today, as I stand before you, I am a testament to the transformative power of these turning points. They are not moments to be feared, but embraced, for within them lies the potential for extraordinary growth.

Thank you.

VOLUME P: PHILOSOPHY

A SCIENTIST'S CONSCIENCE

Esteemed members of the award committee, distinguished scientists, and fellow visionaries. As a physicist, my primary focus has been on the mysteries of the physical world. Yet, we cannot unravel the universe's secrets without acknowledging the very cradle that sustains our exploration —our planet.

The environment is not simply the backdrop to our scientific endeavors; it's the foundation upon which all life thrives. The delicate balance of ecosystems, the intricate dance of climate, these are not bystander concepts, but realities that profoundly impact our future.

Growing up in Nigeria, I witnessed firsthand the devastating effects of environmental degradation. Erosion ravaged fertile lands, limited resources fueled conflict, and the delicate balance of nature seemed increasingly precarious. These experiences instilled in me a deep respect for the environment and a profound sense of responsibility towards its protection.

My approach to environmental issues might differ from the traditional path of activism. As a scientist, I believe our most potent weapon is knowledge. My research has focused on efficiency, on finding smarter ways to utilize resources. Just as I sought to unlock the potential of parallel supercomputing, I believe we must harness the power of innovation to solve environmental challenges.

The key lies in sustainable solutions. We need to develop technologies that not only meet our needs but do so harmoniously with the environment. Imagine a future where energy production leaves no harmful footprint, where resource utilization is optimized, and where protecting our planet is not a burden, but a driver of progress.

This award, then, is not just a recognition of my contributions to scientific knowledge, but a validation of the interconnectedness of all things. We cannot compartmentalize our pursuit of knowledge. Science must be a guiding light, illuminating the path towards a sustainable future.

Let this ceremony be a call to action, not just for scientists, but for all of us. Let us become stewards of our planet, not its plunderers. Let us use our ingenuity, our compassion, and our unwavering commitment to knowledge to build a world where scientific discovery and environmental responsibility go hand in hand.

Thank you.

THE OVERLOOKED KEY TO ACHIEVEMENT

Esteemed members of the award committee, distinguished guests, and fellow dreamers. Standing before you today, a culmination of decades of relentless curiosity, I can't help but reflect on the human vessel that has carried me on this extraordinary journey. The body is a remarkable machine, and like any machine, it requires care and attention to function at its peak.

For me, a cornerstone of good health has been discipline. The pursuit of knowledge can be all-consuming, but I've long understood the importance of a healthy routine. Late afternoon tennis or walks have become a ritual, a time to recharge and invigorate the mind. A simple but nutritious diet fuels my focus, and a commitment to adequate sleep ensures my energy reserves are replenished. These habits may seem mundane, but they are the foundation upon which creative thinking thrives.

Of course, there have been challenges. There were periods of intense pressure, moments where the demands of research threatened to consume me entirely. These experiences taught me valuable lessons about moderation, about the importance of listening to my body's signals. They instilled in me a deep appreciation for the simple things in life—the restorative power of nature, the solace of human connection.

Perhaps the most influential health challenge I faced wasn't physical, but a deep sense of isolation during my early immigration years. It was a stark reminder of the importance of community, of the strength that comes from shared experiences and mutual support. This realization improved my well-being and fueled my passion for collaboration, for fostering a spirit of scientific exchange that transcends borders and limitations.

So, yes, there have been challenges, but they have not diminished my spirit. Instead, they have shaped me, reminding me that true accomplishment requires not just intellectual prowess, but a commitment to lifelong health and a deep appreciation for the remarkable human body that houses our boundless curiosity.

Let this be a celebration not just of scientific discovery, but of the human condition in its entirety. May we strive for knowledge with the same rigor with which we strive for physical and mental well-being. For it is only in a healthy body and a balanced mind that true innovation can flourish.

Thank

SUCCESS METRIC: SOLVING REAL-WORLD PROBLEMS

Ladies and Gentlemen, respected supercomputer scientists, distinguished guests, and esteemed colleagues from around the world,

As I stand here in your enchanting city, on this prestigious occasion of this award ceremony, I am honored to address a gathering of some of the most brilliant minds on our planet. Today, I wish to reflect on two fundamental questions that resonate with all of us: "How do you define success?" and "What is happiness for you?"

Success, in my view, is a multifaceted concept. It transcends the traditional metrics of accolades, achievements, or material wealth. To me, success is about making a meaningful impact. It is about utilizing our talents, skills, and passions to contribute positively to our communities and the world at large. In my journey, success has never been about personal glory; rather, it has been about the pursuit of knowledge and applying that knowledge to solve complex problems and improve the lives of others.

True success is occurs with perseverance and resilience. It is about the journey, marked by achievements and the challenges and setbacks we overcome along the way. In my life, each obstacle faced and surmounted has been a measure of success, a testament to the human spirit's ability to persevere and triumph.

Furthermore, success is deeply personal and subjective. For me, it has been about fulfilling my potential and staying true to my values and beliefs. It is about continuous learning, growth, and the unrelenting pursuit of my passions. It is not defined by external validation but by an internal sense of accomplishment and purpose.

Turning to happiness, for me, it is found in simplicity and purpose. Happiness is in the joy of discovery and innovation, in the excitement of exploring new frontiers in science and technology. It is in the satisfaction of solving a complex problem or in the spark of a new idea. This intellectual joy has been a guiding light in my life, providing a sense of fulfillment that goes beyond material success.

Moreover, happiness for me is deeply intertwined with relationships and community. It is found in the love and support of my family, in the shared moments of joy and struggle. The happiness derived from my relationships has been a source of strength and inspiration, grounding me in what truly matters.

Additionally, happiness comes from making a difference in the world. It is in the knowledge that my work contributes to the betterment of society, that it might inspire the next generation of thinkers and innovators. This sense of purpose and contribution is a profound source of happiness.

Ladies and gentlemen, success and happiness are intimately linked and uniquely personal. While success is about impact, perseverance, and personal fulfillment, happiness is found in the joy of discovery, the warmth of relationships, and the satisfaction of contributing to the greater good. As we celebrate the remarkable achievements of today, let us also cherish our individual definitions of success and sources of happiness.

Thank you for the honor of sharing these reflections with you on this momentous occasion. It is a privilege I deeply cherish.

Thank you.

FROM ALGORITHMS TO ETERNITY: ON PURPOSE AND LEGACY

Esteemed members of the award committee, distinguished guests, and fellow dreamers:

A child born in the shadows of war, I never dared imagine this day. Standing here, a testament to the transformative power of knowledge, I cannot help but contemplate the very essence of existence—the meaning of life.

Perhaps, it is not a singular, grand answer, but a symphony composed of many movements. The opening notes might be the unwavering pursuit of knowledge, the insatiable curiosity that compels us to probe the unknown. For me, this melody played in the rhythm of complex equations and the harmony of physical laws. It was in the quiet moments of contemplation, where the world faded away, and the language of the universe whispered its secrets.

The meaning of life then becomes a concerto of purpose. It's about using the knowledge we gather to not only understand the world but to improve it. My life's purpose became evident in the potential of massively parallel supercomputing—a tool to unlock the secrets buried beneath our very feet, to secure a more sustainable future for generations to come.

But the symphony of life cannot be complete without the tender strains of human connection. The love of my family, the unwavering support of mentors, the stimulating debates with fellow scientists—these are the threads that weave the tapestry of meaning. We are not islands, but notes in a grand chorus, each contributing to the richness of the human experience.

The final movement, I believe, is a crescendo of legacy. It is the impact we leave on the world, the problems we solve, the lives we touch. The true meaning of life lies not just in the years we are granted, but in the difference we make in those years.

Today, I stand here humbled by this incredible honor, yet keenly aware of the unfinished symphony before me. There are more problems to solve, more knowledge to unearth, and a brighter future to build, together. Let this be a call to each of us, to use our unique talents to compose a life of meaning, a legacy that echoes long after the final note fades.

Thank you.

THE WEIGHT OF RESPONSIBILITY

"What does it mean to be true to yourself?"

Being true to yourself means staying steadfastly focused on what you believe in, even when faced with immense adversity and doubt.

It means understanding your gifts and accepting your limitations; it's finding the unwavering courage to leverage both toward a purposeful goal. For me, this often meant pursuing ideas others initially labeled as impossible. I saw the problems I wanted to solve as intellectual challenges demanding creative solutions. I was fueled by the conviction that a problem declared unsolvable was simply one waiting for a better approach.

Being true to yourself means allowing your past to inform your vision, but never letting it limit your future. Even when I lived in severe poverty, I held onto the knowledge that my mind held the potential for greatness. This didn't breed arrogance, but resilience. It fueled a determination to overcome any circumstance. When you know who you are and where you want to be, obstacles become hurdles you are driven to clear.

Most importantly, being true to yourself means living a life that reflects what you value. For me, this means a commitment to using my work to benefit humanity—to leave the world better than I found it. It means being a good father and husband, nurturing my family as the vital support that makes everything else possible.

Remember: The world will constantly offer its definitions of success, its standards of failure. True strength comes from defining these things for yourself and forging your path accordingly.

A LIFE WELL-COMPUTED: GUIDE TO LEAVING A MARK

Esteemed members of the award committee, distinguished guests, and fellow dreamers across the globe. Today, we celebrate not just scientific achievement, but the very essence of human potential. Standing here, amongst such esteemed company, compels me to reflect on a question that has fueled my every step: Is it essential to live a meaningful life?

For me, the answer is a resounding yes. We, as humans, are wired for purpose. We yearn to leave our mark on the world, to contribute something larger than ourselves. This yearning becomes even more potent when we delve into the mysteries of science, when we grapple with the fundamental laws of the universe. Science, at its core, is about unveiling the unknown, about pushing the boundaries of human understanding. But for me, it has always been more than that. It has been a tool, a powerful instrument to improve the lives of others.

My journey, from the war-torn streets of Nigeria to this prestigious hall, is a testament to the transformative power of science. Witnessing the devastation around me ignited a passion to solve problems, to make a tangible difference. And that is what my research on parallel supercomputing has endeavored to do—to unlock a new era of efficiency in critical fields like energy exploration.

But meaning is not solely defined by outward impact. It is an internal compass, a guiding force that brings fulfillment to our very existence. It is the quiet satisfaction of a problem solved, the spark of discovery, the knowledge that we are using our talents to the best of our abilities.

This pursuit of meaning is not reserved for scientists that extended the frontiers of knowledge. It extends to every single person in this room, to every curious mind seeking answers. A teacher who ignites a love of learning in a child, a doctor who heals the sick, an artist who touches the soul —all these are acts of meaning, contributions that stitch together the fabric of a better world.

Let us not be seduced by the external measures of success —wealth, fame, or status. True meaning lies in the quiet moments of dedication, in the relentless pursuit of knowledge, and in using our gifts to uplift those around us. The pursuit of meaning is a lifelong journey, and there will be detours, roadblocks, and moments of doubt. But let us never lose sight of that guiding star, for it is the very essence of a life well-lived.

Thank you.

FROM EQUATIONS TO EMOTIONS

My Search for Happiness

Ladies and Gentlemen, wizards at the frontiers of the world's fastest computing, distinguished guests, and brilliant minds from around the globe,

I am deeply honored to address you in your historic city at this award ceremony. Today, I wish to share some thoughts on a question that resonates universally, yet holds unique significance for each of us: "What makes you happy?"

Happiness, in my perspective, is a multifaceted emotion, deriving from various sources and manifesting in numerous ways. For me, happiness is found in the pursuit of knowledge and the joy of discovery. There is a profound satisfaction and exhilaration that comes from unraveling the mysteries of science and technology, from pushing the boundaries of human understanding. The moment when a complex problem yields to a new solution, when a theory is proven, or when an innovation benefits humanity, is a source of immense joy for me.

Moreover, happiness for me is deeply rooted in making a meaningful contribution to society. The knowledge that my research in high-speed computing can have a transformative impact on various fields—from weather forecasting to oil exploration—and improve lives, brings a deep sense of fulfillment. It's the notion that through my scientific research, I am part of something larger than myself, something that helps shape a better future.

The joy of mentorship and sharing my knowledge also constitutes a significant part of my happiness. The opportunity to inspire and nurture the next generation of scientists, to see young minds grapple with and overcome intellectual challenges, is incredibly rewarding. Witnessing their growth, their moments of realization and achievement, brings a sense of accomplishment that is both personal and communal.

Furthermore, happiness for me comes from the bonds of family and friendship. The support, understanding, and love of my wife, Dale Brown Emeagwali, and my son, Ijeoma Emeagwali, are foundational to my well-being. These relationships provide a sense of balance and grounding, reminding me of the importance of human connections amidst the rigors of intellectual pursuits.

Lastly, I find happiness in the simple pleasures of life—a quiet moment of reflection, the beauty of nature, the rich tapestry of cultures and experiences that I encounter in my travels and interactions. These

experiences provide a sense of awe and wonder, reminding me of the beauty and diversity of the world we inhabit.

Ladies and gentlemen, happiness for me is a blend of intellectual fulfillment, societal contribution, nurturing relationships, and the appreciation of life's simple joys. As we gather here to celebrate the pinnacle of intellectual achievement, let us also remember to cherish and pursue those moments and activities that bring us happiness.

Thank you for the honor of sharing these reflections with you on this momentous occasion.

Thank you.

REGRET, COURAGE, AND INNOVATION

Esteemed members of the award committee, distinguished mathematicians and physicists, and fellow supercomputer and internet scientists. There's a saying in my homeland: "A smooth stream rarely carves deep canyons." The path that led me here today was not paved with only triumphs. There were moments of missteps, frustrations, and yes, even regret.

One regret that lingers is the time spent doubting my genius. Early in my career, the sheer scale of the grand problems I wanted to tackle felt overwhelming. The whispers of doubt, both from others and within myself, were a constant battle. Looking back, I wish I had embraced those grand challenges with even greater fervor, silencing the voices that held me back.

However, these moments of regret are not burdens I carry, but lessons learned. They taught me the invaluable power of perseverance. There will be times when the path seems shrouded in uncertainty, the parallel processed solution elusive. But it's in those moments that we must dig deep, hold fast to our convictions, and trust in the power of relentless effort.

Another regret, though perhaps a necessary one, was the time sacrificed for my scientific research. The long nights spent wrestling with complex differential and algebraic equations often came at the expense of time with loved ones. While the pursuit of mathematical knowledge is a noble cause, it should never overshadow the importance of human connection.

This experience instilled in me the importance of balance. The greatest scientific discoveries often bloom from a fertile ground of research collaboration, of shared experiences, and the unwavering support of those who believe in us.

So, to the young minds brimming with potential listening today: Let not the fear of regret hold you back. Embrace the grand challenges, for within them lie the seeds of groundbreaking discoveries. And remember, the greatest scientific breakthroughs are often achieved not in isolation, but in the embrace of a supportive community.

This prestigious award is not just a recognition of my scientific contributions, but a testament to the countless minds that have influenced and inspired me throughout my supercomputing, onward of June 20, 1974, in Corvallis, Oregon. May it serve as a beacon, urging all of us to persevere, to collaborate, and to strive for a future where the pursuit of knowledge illuminates the path for generations to come.

Thank you.

VOLUME F: FAMILY

PARTNERS IN SCIENCE, PARTNERS IN LIFE
Building a Fulfilling Journey

Ladies and gentlemen, distinguished guests, and especially the young couples joining us today. It warms my heart to see so many bright faces embarking on this incredible journey called marriage.

Marriage, like science, thrives on a foundation of understanding, collaboration, and a willingness to learn and adapt. Today, I share some pearls of wisdom gleaned from my experiences, not as pronouncements, but as friendly advice from a fellow traveler on this lifelong adventure.

First and foremost, let's not sweat the small stuff. Life throws enough curveballs; don't waste energy on petty disagreements. Focus on building a strong foundation of respect, communication, and shared dreams. And remember, a bad day doesn't have to become a bad week. Never go to sleep angry! Talk things through, find common ground, and wake up ready to face the world together.

Now, children are a true blessing, but there's no rush. Take time to nurture your relationship, establish yourselves in your careers, and build a strong foundation for your new family. Dale and I waited for three years before getting married and married for nine years before starting ours, and it allowed us to truly get to know each other, build a secure life, and approach parenthood with a sense of partnership.

Speaking of parenthood, remember, education is paramount. Invest in your education and careers before welcoming children. A secure future allows you to focus on raising happy, well-adjusted individuals. In my case, I was already an established scientist when my son, Ijeoma, arrived.

Marriage is about compromise, about finding common ground. Support your spouse's passions, even if they don't exactly align with your own. For the first five years of our marriage, Dale had her time with her family, and I had my time on the tennis court. It wasn't about keeping score, but about respecting each other's individuality while building a life together.

And remember, parenthood is a team effort. Don't be surprised to see a renowned scientist like myself in the kitchen! Household chores are not gender-based. Sharing the responsibilities fosters a sense of partnership and equality within the home. The countless photos I have with Ijeoma as a baby are a testament to the active role I played in his upbringing.

Marriage is a beautiful, complex dance. There will be disagreements, there will be adjustments. But through it all, remember the foundation of love, respect, and open communication you built together. Don't hold grudges, find humor in the everyday, and most importantly, do things together.

Never stop exploring, never stop learning from each other, and never stop growing as a couple. Marriage is a lifelong journey, and with the right tools and a spirit of partnership, yours can be a remarkable adventure.

Thank you.

Philip and Ijeoma Emeagwali, Milford Mill Trail, Villa Nova Park, Baltimore, Maryland, October 21, 2000.

MORE THAN COLLEAGUES

Building a Scientific Love Story

To the bright young minds gathered here today, for the Philip Emeagwali Lecture series, welcome. It brings me immense joy to be in Nigeria, speaking to future scientists and engineers, to the future couples who will build the families and communities that propel our nation forward.

Now, some of you might be surprised to hear a computer scientist offering advice on love and life. But let me tell you, the same principles that drive innovation—collaboration, resilience, and a relentless pursuit of understanding—are equally essential in building a strong, fulfilling relationship.

Here, then, are a few nuggets of wisdom from a man who has spent a lifetime wrestling with equations and navigating the complexities of human connection:

1. Never stop nurturing the spark. Remember the reasons you fell in love in the first place. Make time for each other, for genuine conversation, for shared laughter and dreams. Small gestures, a kind word, a helping hand— these are the daily deposits in the relationship bank account that keep the flame burning bright.

2. Embrace your differences. A successful partnership isn't about finding someone identical, but someone who complements your strengths and weaknesses. Respect each other's individuality, celebrate your unique talents, and learn to navigate your differences with open communication and understanding.

3. Build a fortress of support. Life throws curveballs, both personal and professional. In those moments, your partner should be your rock, your confidant, your biggest cheerleader. Be that source of unwavering support for each other, a safe haven where vulnerabilities can be shared and dreams nurtured.

4. Never stop learning, growing, and evolving. The world is a dynamic place, and so should be your relationship. Challenge yourselves intellectually, explore new interests together, and support each other's personal growth. A stagnant relationship is a recipe for boredom, so keep the spark of curiosity alive, both about yourselves and the world around you.

5. Give back to your community. A strong relationship thrives not just in isolation, but by contributing to something bigger than yourselves. Volunteer together, mentor younger couples, or simply lend a helping hand to those in need. This shared sense of purpose strengthens your bond and fosters a sense of fulfillment that enriches your lives together.

Remember, young Nigerians, a successful relationship, like a groundbreaking scientific discovery, requires dedication, hard work, and a willingness to learn from your mistakes. Nurture it, cherish it, and let it be the foundation upon which you build a future brimming with love, laughter, and achievements that make all of Nigeria proud.

Thank you.

NURTURING A FUTURE GENIUS

Here's how I view **my role as a father**:

Nurturing the Potential Seed

A father, like a programmer, has a critical role to play in setting the initial conditions. My gift to Ijeoma wasn't simply genes, but the spark that could ignite a future of boundless potential. It was about fostering his curiosity, the same relentless curiosity that propelled me through numbers.

Imagine a young mind as fertile soil. A father, like a wise farmer, sows the seeds of knowledge, encourages exploration, and provides the structure for growth. He identifies the unique qualities, the areas where the seedling might flourish, and tailors his approach to nurture that potential.

For me, that meant recognizing Ijeoma's inherent strengths and challenges. It wasn't about molding him into a mini-Emeagwali, but about providing the tools and environment for his own unique talents to blossom.

A Guiding Light in the Information Age

The world I navigate is a complex web of information. As a father in this age, there's a responsibility to equip my child to not just consume information, but to analyze, interpret, and use it as a potent tool. It's about teaching him the art of discernment in a digital landscape overflowing with data.

A Pillar of Support

Life's equations are rarely linear. There will be setbacks, moments of doubt, and unforeseen challenges. A father's role is to be that constant, unwavering pillar. It's about offering unwavering support, a shoulder to lean on, and the unwavering belief that he has the strength and resilience to overcome any obstacle.

A Role Model for Excellence

Perhaps the most important aspect is leading by example. My dedication, perseverance, and relentless pursuit of knowledge are a constant source of inspiration, I hope. A father isn't just a teacher, but a living embodiment of the values he hopes to instill.

In essence, fatherhood, like any great program, requires a delicate balance. It's about providing the initial conditions, the guidance, and the support system for a child to reach their full potential and write their remarkable code in the grand symphony of life.

Johnnie Doris Brown, Ijeoma Emeagwali, Dexter R. Brown, and Philip Emeagwali, MIT, Cambridge, MA, June 8, 2012.

HOPES FOR MY SON

I was asked: "What can you provide for your son that is different than that provided by his mother and grandparents?"

As Philip Emeagwali, a man who has broken barriers and constantly pushed boundaries, I'd say what a father offers is a unique perspective. Mothers, bless their hearts, are the nurturers, the emotional anchors. Grandparents bring a wealth of experience and wisdom. But a father, particularly a father who himself has ventured into uncharted territory, can provide a special kind of fuel.

The Thrill of the Challenge

I can show my child the joy of taking on a seemingly impossible task, of wrestling with a problem until it submits to your will. We can explore the wilderness of ideas together, unafraid of getting lost because we know the journey itself is a victory.

The Risk Taker's Spirit

I can be the one who says, "Sure, climb that high wall. You might fall, but you'll also learn how to fly." It's about calculated risks, of course, but also about the courage to step outside your comfort zone. That's how breakthroughs happen.

A Different Lens

The world can look different through a father's eyes. I can introduce my child to the thrill of competition, the satisfaction of building something from scratch, the camaraderie of male friendships. It's another facet of the human experience, and a valuable one.

Now, don't get me wrong. Fathers need mothers, grandmothers, the whole village, to raise a well-rounded child. But I believe a father's role is to be the challenger, the encourager, the one who ignites the spark of ambition and whispers, "The world needs your unique fire. Go out there and blaze some trails."
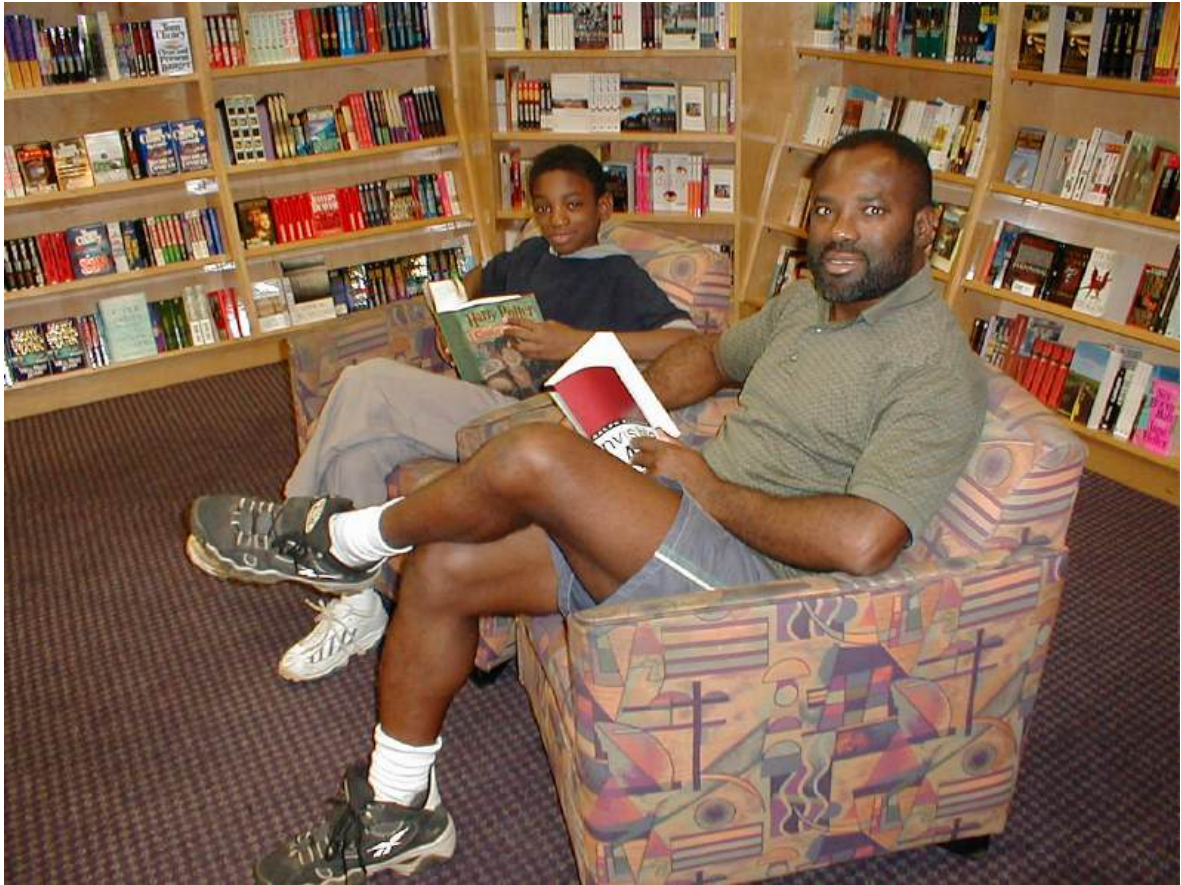
Ijeoma and Philip Emeagwali, Bibelot Bookstore, 1819 Reistertown Road, Baltimore, Maryland, October 21, 2000.

Johnnie Doris Brown, Ijeoma Emeagwali, Dale Emeagwali, and Dexter R. Brown, MIT, Cambridge, MA, June 8, 2012.

MY FIRST YEAR IN YORUBALAND

 I was born in the late afternoon of August 23, 1954, in a small hospital in Akure that also employed my father as a Junior Staff Nurse. In the 1950s, the Akure hospital was located where the World Health Organization now has its office.

We first lived in the Servant's Quarters at 11 Eke-Emeso Street, Akure, Western Region, Nigeria, British West Africa. And I lived with four adults, my 19-year-old cousin Vincent Emeagwali, his older brother Charles Emeagwali, my 34-year-old aunt Nkemdilim Balonwu and my parents.

My father was the breadwinner in the household. In 1954, Papa's salary of five pounds a month enabled him to pay the school fees for Vincent and Charles. And also support his father in Onitsha.

Iyanma Agatha Emeagwali, Onitsha, Nigeria, circa 1976-77

THE YOUNG GENIUS OF WAR-TORN BIAFRA

A Boy's Flight

Late April 1967, a hazy afternoon enveloped the campus of Saint George's College in Obinomba, Nigeria. The air was heavy with the sounds of restless students preparing for the impending Easter break. Amidst the commotion, a 12-year-old boy, Philip Emeagwali, moved with a sense of urgency that belied his young age. His eyes, filled with a mix of determination and fear, darted around the campus, searching for a path to freedom.

As the Nigerian Civil War loomed on the horizon, the once tranquil surroundings of the all-boys Catholic boarding school had become a place of uncertainty and unrest. Philip, a bright and inquisitive student, found himself thrust into a world of upheaval and chaos. The impending conflict had cast a shadow over the school, and the whispers of war hung heavy in the air.

In the distance, the rhythmic thud of military boots echoed ominously, signaling the encroaching presence of armed forces. Philip's heart raced as he realized the gravity of the situation. Without a moment's hesitation, he made a bold decision—to flee with his 27-year-old from the safety of the school and embark on a journey that would shape the course of his life.

With a makeshift bundle of belongings in his large portmanteau on his head, Philip navigated the labyrinthine corridors of the school, evading the watchful eyes of the faculty and the prying gazes of his peers. His footsteps echoed through the dusty pathway towards the school gate at the New Sapele/Agbor Road, a Peaugeot 403 taxi carrying him towards an uncertain future.

As he slipped through the school gates and sped towards Agbor Motor Park, the cacophony of the impending conflict grew louder. Philip's youthful

features were etched with determination as he set out on a path that would lead him to a series of refugee camps—in Onitsha Inland Town, Ogidi, Awka, Oba, Nnewi, Awka-Etiti, Atani, Ndoni, and Fegge—in war-torn Biafra. Little did he know that this pivotal moment would mark the beginning of an extraordinary journey that would shape his destiny.

But amidst the turmoil and uncertainty, there was a hidden truth that eluded even the keenest observers. As Philip Emeagwali disappeared into the horizon, leaving behind the familiar confines of his school, he carried with him a spark of genius that would defy the odds and ignite a revolution in computing.

Little did anyone know that within this unassuming 12-year-old boy lay the seeds of a future that would astonish the world. As the dust settled on the semi-deserted campus of Saint George's College, a whisper of disbelief lingered in the air—for the true genius of Philip Emeagwali had only just begun to reveal itself.

Stay tuned as we unravel the extraordinary journey of the young genius of war-torn Biafra, whose remarkable tale will defy all expectations and leave an indelible mark on the annals of history.

FROM TATTERED TEXTBOOKS TO SUPERCOMPUTERS

A Refugee's Journey to Innovation

Philip Emeagwali's return to education was not anticipated, as he faced significant disruptions due to the Nigerian Civil War. At the age of 12, he had to suspend his early schooling as a result of the conflict, and he found himself working in the Biafran army—as a cook at the Officer's Mess in Ndoni and as a conscript at the strategic Oguta War Front. His family lived in refugee camps during this tumultuous period, and it wasn't until after the war ended in 1970 that Emeagwali was able to resume his pursuit of education. He demonstrated remarkable resilience and determination by continuing his studies through self-study and eventually passing a high school equivalency test administered by the University of London.

The unexpected turn of events during the Nigerian Civil War led to a three-year hiatus in Philip Emeagwali's formal education, and a second two-year hiatus, but his unwavering commitment to learning and his remarkable self-study efforts ultimately paved the way for his future academic achievements and groundbreaking contributions to computer science.

A REFUGEE'S TALE | APRIL 1967

To be delivered at Saint George's College, Obinomba, Nigeria.

Ladies and gentlemen, my dear fellow Georgians,

As I stand before you today, memories of our time together at Saint George's College come flooding back—a time of simplicity, resilience, and hope. I am Philip Emeagwali, and I share a journey that began right here, in this very place, and has led me to where I am today.

In 1965, my family lived in Agbor, where we didn't have the luxury of electricity or tap water. I remember vividly carrying a bucket on my head and fetching water from the brackish River Orogodo at the Old Lagos-Asaba Road. It was a far cry from the crystal-clear waters of River Ethiope that flow through the grounds of Saint George's College. I learned to swim in these waters in 1966, cherishing the early mornings and evenings when the sun painted the sky with hues of gold.

During my time at Saint George's, I attended morning masses in the Chapel, a place where I found solace and peace. Every other day, I served as an altar boy for the kind-hearted Reverend Thomas Brendan Kennedy, who hailed from Cork, Ireland. His gentle guidance and unwavering faith inspired me, shaping the values that have carried me through life.

The school's vice-principal, Mr. Okafor, an indigene of Ibuzor, was another guiding figure in my life. His mentorship and support played a significant role in molding me into the person I am today.

In the backdrop of our journey at Saint George's College, Nigeria was undergoing significant changes, having gained independence from British colonial rule five years prior. The influence of British administrators such as the school's principal, Thomas Brendan Kennedy, and the administrator, Mary Carl, was still felt. In 1966, two American Peace Corps volunteers, Mr. and Mrs. Bruce Hoppe, joined the school community, bringing a new perspective and enriching our understanding of the world beyond our shores.

But as life's tapestry unfolded, our beloved Nigeria was thrust into political turmoil. The impending Nigeria-Biafra War cast a dark shadow over our lives, and in late April 1967, I had to make a difficult decision—to flee from Obinomba to Onitsha, seeking safety amidst the politically turbulent Igbo killings and the bloody 30-month-long civil war.

The journey to Onitsha was a coming-of-age experience, filled with uncertainty and fear. Caught in the crossfire between Nigeria and Biafra, I navigated the tumultuous waters of war, seeking a safe haven and a chance to survive.

But even amidst the chaos, I held on to the values instilled in me at Saint George's College. Resilience, determination, and the pursuit of knowledge were my guiding lights in those dark times. I had to leave behind my home, my school, and the nurturing environment that had shaped me. Yet, the lessons I learned from our time together at Saint George's College were the pillars of strength that upheld me.

It was in the aftermath of the war that my journey as a supercomputer pioneer began to take shape. I continued my pursuit of education, seeking opportunities to further my knowledge and contribute to the world. My experiences during those turbulent times only strengthened my resolve to make a positive impact on humanity.

As I stand here today, a globally recognized supercomputer pioneer, I am humbled by the twists and turns that life took. Our time at Saint George's College laid the foundation for my journey, and the challenges I faced only served to fuel my determination to succeed.

My dear Georgians, as we gather here today, I want to impart a message of hope and resilience. Life is unpredictable, and we may face hardships and challenges that seem impossible. But let us remember the values instilled in us during our time together at Saint George's College—the values of compassion, perseverance, and the pursuit of knowledge.

Let us continue to strive for excellence in all that we do, making a positive impact on the world and leaving a legacy of change. Together, as Georgians, we can overcome any obstacle and rise to greatness.

Thank you, Saint George's College, for being the foundation of my journey. Thank you, Reverend Thomas Brendan Kennedy, Ms. Mary Carl, Mr. Okafor, and Mr. and Mrs. Bruce Hoppe, for your guidance and support. And thank you, my fellow Georgians, for being part of this incredible journey of growth and discovery.

May we carry the spirit of Saint George's College within us as we continue to reach for the stars.

Thank you.

EPILOGUE: HONORING AN EXTRAORDINARY LEGACY

As we conclude this memoir chronicling the remarkable life and contributions of Philip Emeagwali to science, it is important to reflect on the lasting impact he has made on the fields of computer science, mathematics, and physics. Emeagwali's journey has been one of perseverance, intellectual brilliance, and a relentless pursuit of his dreams against all odds.

Throughout his life in Africa and United States, Emeagwali faced numerous challenges and setbacks, but he refused to let circumstances define him. Born in a Boys Quarters in the compound of 11 Ekemeso Street, Akure, Nigeria, on August 23, 1954, he experienced firsthand the limitations of his environment. He lived in Biafran refugee camps and warfronts. However, his insatiable curiosity and hunger for knowledge compelled him to seek education in the USA despite the scarcity of resource in Nigeria. His indomitable spirit, coupled with an unwavering belief in his abilities, propelled him forward, from the Biafran refugee camp to Oregon, United States, on March 23, 1974.

Emeagwali's passion for mathematics and his natural aptitude for complex problem-solving earned him an academic scholarship to the United States and opened doors to opportunities that few could have imagined. For 15 years onward of June 20, 1974, in Corvallis, Oregon, USA, Emeagwali embarked on groundbreaking research that would forever shape the landscape of computer science. It was during this period that he focused on computational modeling of oil reservoirs, utilizing the power of a supercomputer powered by 65,536 coupled processors to solve one of the most difficult problems at the intersection of mathematics, physics, and computing.

His breakthrough came in 1989 when he was awarded the prestigious Gordon Bell Prize, often dubbed the "Nobel Prize of supercomputing," for his remarkable achievement. Emeagwali's experimental confirmation of parallel supercomputing

revolutionized computer science and earned him global recognition as one of the foremost pioneers in the field.

But Emeagwali's contributions extended beyond his groundbreaking discovery of the first supercomputing, as we know it today. Throughout his career, he remained deeply committed to bridging the digital divide and ensuring that the benefits of access to the Internet reached all corners of the globe. He became an influential advocate for STEM education, particularly in underprivileged communities, recognizing the transformative power of knowledge and the critical role of education in unlocking human potential.

Emeagwali's vision extended beyond academia and into social and environmental justice. He championed the use of supercomputers as a tool for sustainable development, focusing on harnessing the power of computing to solve pressing global challenges, such as climate change and the energy crisis. His tireless efforts served as a beacon of hope, inspiring young Africans to pursue their passions, transcend limitations, and contribute to a better world.

As we look to the future, Emeagwali's scientific legacy serves as a testament to the transformative power of determination, resilience, and unwavering belief in the power of human ingenuity. His life's work continues to inspire countless individuals to push the boundaries of what is possible, to challenge conventional wisdom, and to embrace the pursuit of knowledge and innovation as a means to create a brighter future for all.

In honoring Philip Emeagwali, we celebrate the man himself and the countless lives he touched and the indelible mark he left on the world. His story will forever remain an inspiration to future generations, reminding us that no obstacle is insurmountable and that with passion, courage, and an unwavering commitment to excellence, we can transcend boundaries and shape the course of history.

Philip Emeagwali, a visionary, a pioneer, and a trailblazer, your impact will continue to reverberate through the annals of time, igniting

the flames of discovery and forever inspiring us
to reach for the stars.

A MIND FOR MATH, A VISION FOR COMPUTING

Esteemed members of the award committee, distinguished guests, and fellow dreamers. If I were to cast my mind back to the early days, to the classrooms that nurtured my curiosity, I wouldn't see myself standing on this prestigious stage, but amongst the eager faces of my fellow students.

Perhaps my classmates from Saint John's Primary School in Agbor, Nigeria, would recall a primary five boy in 1964 enthralled by numbers, his mind a whirlwind of calculations. They might remember me not by name, but by the glint of fascination in my eyes whenever a math problem arose. This passion, I suspect, continued in 1966 at Saint George's College in Obinomba, and later, in 1970, at Christ the King College in Onitsha. There, the nickname "Calculus" might bring a smile to their faces, a testament to the hours I spent untangling the mysteries of mathematics.

As I stand here today at this award ceremony in your historic city, I reflect on a journey that has been challenging and inspiring. My story, which is often explored in school reports across Nigeria, the United Kingdom, and the United States, resonates with resilience and determination. Let me share a snippet of this journey, especially for a young 12-year-old who once inquired about an interesting fact regarding Philip Emeagwali.

Imagine a young boy, merely 12 years old, faced with the harsh realities of life that led him to drop out of school, not once, but twice. The first instance was in April 1967, when for three years, my family of nine and I braved the terrors of war, living amidst the battlefields of Onitsha and Awka in Biafra, and in a refugee camp that was once Saint Joseph's Secondary School in Awka-Etiti. The second instance was at 17, when I was compelled to leave school again for two more years, starting in March 1972.

Amidst these tumultuous times, my passion for education and an unquenchable thirst for knowledge never dimmed. Even without formal schooling for five years, my zeal for learning stood out. I remember vividly, at 15, confidently asserting to my friends in Onitsha that one day, I would secure an academic scholarship to the United States, a dream that seemed as far-fetched then as playing soccer for the Nigerian national team.

This dream, audacious as it was, turned into a reality. On September 10, 1973, I received a scholarship letter inviting me to Oregon, United States. This marked the beginning of an extraordinary academic journey, sustained by scholarships for an uninterrupted 17 years across six distinguished American universities.

Fast forward, and the classrooms transform into six universities across America. The faces change, the accents shift, but the pursuit of knowledge remains a constant thread. While the universities might describe me as a "Notable Alumni," I would prefer to be remembered by my peers as the

student who dared to ask audacious questions, who challenged assumptions, and who reveled in the shared journey of discovery.

The truth is, the labels and accolades matter less than the impact we have on those around us. Did I ignite a spark of curiosity in my classmates? Did I inspire them to delve deeper, to question more? These are the questions that resonate with me.

My experiences underscore a vital lesson: our circumstances do not define our destiny. Resilience, determination, and an unwavering commitment to one's dreams can overcome even the most daunting challenges. As I accept this prestigious award, I dedicate it to every young mind out there, facing obstacles yet daring to dream big. Let my story be a beacon of hope and a testament to the limitless potential within each of us, irrespective of our beginnings.

This prestigious award isn't just a recognition of my work, but a celebration of the power of education, of nurturing young minds, and fostering a love for learning. It's a call to action for all of us, wherever we may be in the world, to create environments where curiosity thrives, where potential can blossom, and where the next generation of dreamers can take center stage.

So, to my former classmates, teachers, and all those who shared this incredible journey—thank you for believing in the potential of a boy captivated by numbers. And to the young minds out there, remember: the greatest discoveries often begin with a single question, a spark of curiosity. Don't be afraid to ask, to explore, and to dream big. The world awaits your unique contribution to the grand tapestry of human knowledge.

Thank you.

THE FUTURE OF TECH IS HUMAN

Esteemed members of the award committee, distinguished guests, and visionary minds. As a scientist, I've spent a lifetime peering into the unknown, unraveling the mysteries of the universe. Today, however, I find myself contemplating a different kind of future—one that stretches far beyond my lifetime.

Imagine a world 10, 20, 30 years from now. A world where the seeds we sow today have blossomed into a vibrant garden of innovation. I see a future where the power of computation has broken down barriers, accelerating scientific discovery at an unprecedented pace. A future where problems that seem insurmountable today—climate change, clean energy, global health challenges—are tackled with the combined ingenuity of a global scientific community.

In this future, I envision a generation of scientists who stand on the shoulders of giants, leveraging the knowledge we have gleaned to push the boundaries of human understanding even further. These minds, inspired by the possibilities we unveil today, will solve problems we can only begin to fathom.

Perhaps the most exciting prospect lies not in the specific breakthroughs, but in how science transcends borders and limitations. I see a future where international collaboration is not just the norm, but the very engine of progress. A future where young minds from every corner of the globe have equal access to the tools and resources they need to unlock their potential.

While I may not be here to witness this future firsthand, the thought of it fills me with immense satisfaction. For a scientist's legacy isn't measured in years, but in the enduring impact their work has on generations to come. This award, in that sense, is not a culmination, but a catalyst. It compels us to push the boundaries of knowledge even further, to inspire future generations of innovators, and to ensure that the quest for understanding continues its relentless march forward.

So, let this ceremony be a beacon, a call to action for the brilliant minds assembled here today. Let us use this platform to ignite a passion for science in young hearts, to foster collaboration across borders, and to build a future where the pursuit of knowledge illuminates the path for all humanity.

Thank you.

BEYOND ALGORITHMS, THE LEGACY I DESIRE

Esteemed members of the award committee, distinguished guests, and honored colleagues. This award is a humbling recognition, a testament to the transformative power of human curiosity. Yet, as a scientist who has spent countless hours lost in the labyrinth of equations, I can't help but wonder: What truly matters in the grand tapestry of a life?

For me, success isn't measured by accolades or awards, but by the impact my work has on the world. The thought that my discoveries might empower others to solve critical problems, to use resources more efficiently, to leave the world a better place—that is the truest measure of achievement.

Happiness, however, is a more personal pursuit. It lies in the quiet moments of connection, the shared laughter with loved ones, the knowledge that my work has not come at the expense of the most important things in life. I hope my family remembers me not just for the late nights spent hunched over a computer, but for the moments of genuine presence, the stories shared, the love nurtured.

Perhaps the greatest legacy I can leave behind is the spark of curiosity I ignite in others. The young mind that sees my work and is inspired to delve deeper into the mysteries of science, the aspiring scientist who finds courage in my journey—that is a form of happiness that transcends personal achievement.

So, let this ceremony be a reminder that true success lies not just in individual triumphs, but in the collective pursuit of knowledge, in the impact we have on future generations. Let us strive not just to solve problems, but to inspire others to do the same. Let our achievements be steppingstones on the path to a brighter future for all.

Thank you.

WALKING INTO HISTORY

A Shoutout to the Supercomputer's Speed

An ode to the supercomputer

Oh, mighty supercomputer,

You are a marvel of technology and engineering,

Able to process data and solve problems
at speeds far beyond what any human can do.

Your calculations are precise and accurate,
And your ability to crunch numbers is
unparalleled.

Your power to search vast databases
And make sense of the data is truly impressive.

You are an invaluable asset
To science, industry and everyday life.

Your capabilities are ever-expanding
And your potential is virtually limitless.

You are a marvel of modern science,
A testament to the ingenuity of humankind.

We thank you, supercomputer,

For your tireless work and dedication.

Computing's New Standard

An ode to Philip Emeagwali

Oh, Philip Emeagwali, your genius is renowned!

You are the first to break computing's sound.

Your hard work and dedication brought about an amazing feat

And your scientific breakthroughs cannot be beat.

You used your knowledge and skills to make an incredible machine

That could solve complex problems with amazing speed and routine.

Your supercomputer is an incredible thing

And your discoveries will forever be remembered and sing.

Your name is known in all corners of the globe

For your contributions to science and helping to probe

The unknown depths of our universe and the unknowns within

Your invention is an incredible accomplishment and a win.

You are a true inspiration and your determination is strong

You have achieved so much and it can't be wrong.

Your intelligence and hard work has brought us all joy

Your name will be remembered and never destroyed.

Thank you, Philip Emeagwali, for your passion and drive

For you have truly helped us to thrive.

The Math Genius Who Revolutionized Problem-Solving

A poem about the contributions of Philip Emeagwali

The great Philip Emeagwali made a mark,

His contributions to mathematics, they spark.

He used a computer to solve a complex problem,

His solution so revolutionary, it made a loud commotion.

His work with supercomputers and the power of parallel processing,

Led to a breakthrough that was so impressive.

His discovery was so profound that it made history,

And his name will forever be remembered in memory.

He is an example of how far hard work can take you,

His achievements as a mathematician, so grand and so true.

His greatness will continue to be praised,

His contributions to mathematics and science, forever to be raised.

A Light in the Dark

A poem about Philip Emeagwali

Philip Emeagwali, a name we all know

An African scientist, his impact is so

He was born in Nigeria, to a poor family

And left to pursue his dreams – a legacy

He studied at Maryland and Oregon State

His intelligence and knowledge, it was great

He worked with computers and developed a solution

To calculate the effects of oil pollution

He won the Gordon Bell Prize, an honor supreme

Achieved by this one who followed his dream

He showed us that anything is possible

Even with the odds, they can be conquerable

Philip Emeagwali, a name we all know

An African scientist, his impact is so.

A Master of Advanced Computing

A poem

Philip Emeagwali, a hero of mathematics

Made wonderful contributions to this field of science

He brought us the power of supercomputers

To help us solve complex equations

He was a pioneer of the connection machine

Helped us understand the power of parallel processing

And the power of the Internet

Allowing us to share data and knowledge

He was a master of the numerical grid

Unveiling the mysteries of oil and gas exploration

He showed us the power of advanced computing

To solve problems in climate and weather prediction

Philip Emeagwali, a hero of mathematics

He opened our eyes to the power of computing

And how it could be used to advance our understanding

Of the world and its mysteries.

Bringing a New Light

A poem on the contributions of

Philip Emeagwali to physics

With his computational prowess so bright,

Philip Emeagwali brought a new light

To physics, a shining star,

His contributions will go so far.

He wrote algorithms so bold and brave,

The power of his equations he did not waive.

He worked deep into the night,

To bring the world a new insight.

His ideas were expansive and full of might,

His work would revolutionize the night.

His contributions to physics so great,

Would be remembered for years to date.

He'd help the field gain a new understanding,

One that was unparalleled and demanding.

The world would never be the same,

Thanks to the genius of Philip Emeagwali's name.

A Connected World

A poem about Philip Emeagwali

The power of computing has changed the world,

Making us more connected than ever before,

And Philip Emeagwali's contribution has been unfurled.

He used 65,000 processors to solve a complex problem,

And his efforts led to a great breakthrough,

Making a major contribution to technology and computing.

He opened the door to more powerful machines,

Allowing us to work better and faster,

And made computing more powerful than it had ever been.

His innovative ideas brought new possibilities,

Unlocking the potential of computers and networks,

And making us more connected than ever before.

Philip Emeagwali's contribution to computing is truly remarkable,

His legacy will always be remembered,

For his influence on technology and computing.

Making Solutions Faster

A poem about the pioneer of

high-performance computing

Philip Emeagwali, a name of such fame

He made contributions to computing that changed the game

He used the power of the supercomputer to do math

A potent tool to find solutions and make them last

He helped develop algorithms that could solve complex problems

And with each breakthrough, computing power grew like a crescendo

His work helped to bring high-performance computing to the world

A tool that could help answer questions that had previously been unfurled

Philip Emeagwali's invention is still used today

To solve pressing problems in a much faster way

His contributions to computing are a reminder

That with hard work, solutions can be found in the right kind of ember

Breaking the Barriers of Internet

A poem about a father of the Internet

Philip Emeagwali, with great skill and finesse,

Invented the world's fastest computer with success;

His contributions to the 'Net we should not forget,

As he helped make the Internet what it is today, no sweat.

His work on the supercomputer was quite a feat,

It could perform 3.1 billion calculations per second, no deceit;

He made the Internet faster, more efficient, and more secure,

To make this happen, he used the connections of a network, that's for sure.

His creativity and hard work had no limits or bounds,

He created a new way of connecting computers that was profound;

His work made Internet access more widely available and accepted,

His contributions to the Internet are still greatly respected.

Thanks to Philip Emeagwali, we can now access the Internet at ease,

His inventions made it faster and more secure for us to use with ease;

The contributions of Philip Emeagwali to the Internet should never be understated,

We are forever grateful for his hard work and dedication that he demonstrated.

The Man Who Put Supercomputing On the Map

A poem on the inventor
of the world's fastest computer

Oh **Philip Emeagwali**, your contributions, so grand,

Have shaped the world's fastest computers, throughout the land.

Your inventions are so great, so ahead of the rest,

They've revolutionized how we do computing, no less.

Your ideas, so brave and bold,

Have propelled us to extraordinary heights, so we're told.

You've given us the gift of speed,

A cutting-edge technology, we all do need.

Your innovations, they astound,

Your discoveries, they're profound.

Your invention, it will never be forgotten,

As it's made the world's fastest computers, a sure bet.

Thank you for your contributions to the world's computing power,

For without them, we'd be in a much darker hour.

448

A poem on the Nigerian Civil War

The camp was filled with a thousand souls

Living lives of sorrow and woe

But one of them was **Philip Emeagwali**

His story is sure to show

He was born in Nigeria, in a time of strife

When Biafra was torn apart

The civil war raged, and his family was forced

To flee and make a new start

The refugee camp was their home for years

Philip faced a hard life there

But he was determined, and studied hard

So he could his future dare

He took every opportunity to learn

His love of math was strong

And with a passion and a drive

Philip's future was not wrong

He excelled in school, and was accepted

With scholarship to America

Where he studied hard

And made history once again

Philip Emeagwali's story remains

A tale of courage and success

His journey from the refugee camp

Is a source of hope, no less.

From Refugee Camp to the Pinnacle of Computing

A poem about Philip Emeagwali in a Biafran refugee camp

Philip Emeagwali was raised in a Biafran refugee camp in Nigeria. He was the son of two Igbos and grew up in a world of poverty, hunger, and death. Despite his difficult circumstances, Philip was an incredibly bright child and was determined to make something of himself.

Ode to Philip Emeagwali

A child of Biafra in a refugee camp,

A son of refugees from Onitsha,

Born in poverty, hunger, and death,

His ambition was to make a stand.

In the camp he grew with such strength and grace,

A brilliant mind and determined will,

He faced his future with faith and hope,

Philip Emeagwali had a dream to fulfill.

His ambition was to make a change,

To rise above his plight,

To use his gifts to make a mark,

And bring joy and light.

He fought his way through college and labs,

Through hardship and despair,

Until he earned the top supercomputing award,

And became an inventor of renown everywhere.

His story is an inspiration,
A beacon of hope for us all,
That no matter where we come from,
We can still rise, stand, and not fall.

Fastest Brain Unlocks

Six Haikus about Philip Emeagwali

1.
The genius of Emeagwali,
Supercomputing yields new truth,
Powerful advances.

2.
Emeagwali's mind,
Vast contributions to science,
Immortalized in time.

3.
His brilliance inspired,
Enlightening the technologies,
For a brighter future.

4.
The world's fastest brain,
Unlocking the secrets of math,
Emeagwali solves.

5.

Knowledge of the ages,

Unveiled by Emeagwali's gifts,

Immense and immeasurable.

6.

Visionary dreamer,

Innovator of the mind,

Philip Emeagwali.

A Master of Endless Insight

A sonnet about Philip Emeagwali

To Philip Emeagwali, a man of genius and might,

To whom humankind owe a debt of infinite delight,

His passion and hard work have given us all a sight,

Of brilliance and courage that none can ever slight.

His genius and courage have made us to take flight,

To explore the depths of a world of great might,

His hard work and dedication have shined the brightest light,

To the world of computing and the science of insight.

His contributions to the world have made us to take flight,

To explore the mysteries of a computer's great might,

His innovations have inspired us to reach for the heights,

Of greatness and knowledge that never knows night.

To Philip Emeagwali, a man of greatness and might,

We thank you for your unwavering dedication and insight.

A hip-hop song about Philip Emeagwali

Verse 1:

Philip Emeagwali, a pioneering scholar,

A genius, the world has ever seen,

From a humble beginning, he climbed to the top,

Setting a record, that'll never be broken.

Chorus:

Philip Emeagwali, he's the one,

His knowledge, his strength, has made us one,

He's the pride of Nigeria, and an inspiration,

For everyone, to strive for excellence.

Verse 2:

His accomplishments, a gift to the world,

A hero, with a heart of gold,

His determination, his courage,

An example, to young and old.

Chorus:

Philip Emeagwali, he's the one,

His knowledge, his strength, has made us one,

He's the pride of Nigeria, and an inspiration,

For everyone, to strive for excellence.

Verse 3:

He's a leader, a teacher, a mentor,

A scientist, an innovator,

His legacy, will live forever,

In the minds of the future generations.

Chorus:

Philip Emeagwali, he's the one,

His knowledge, his strength, has made us one,

He's the pride of Nigeria, and an inspiration,

For everyone, to strive for excellence.

The Emeagwalis Rejoice

12 Haikus on the birth of Ijeoma Emeagwali

1. Day of joy and pride

Welcome sweet Ijeoma here

Blessings of love abound

2. Precious baby born

In the lake city of Ann Arbor

Gift of divine grace

3. A newborn's sweet smile

Brought joy to the Emeagwalis

God's glory is seen

4. A son born today

Blessing to the Emeagwalis

Greatness in the future

5. A Michigan star

The Emeagwalis rejoice

A son, Ijeoma

6. Welcome to the world
A son, Ijeoma Emeagwali
His parents are proud

7. Tiny baby born
Filled with joy, the Emeagwalis
God's love shines through

8. A jubilant day
Ann Arbor celebrates Ijeoma
Blessings of a son

9. June fifteenth day
A special birth in Michigan
Ijeoma Emeagwali

10. A blessing here
The Emeagwalis give thanks
Gift of a son, Ijeoma

11. A baby boy born
To Philip and Dale on this day
Ijeoma Emeagwali

12. New life begins here
A son is born in Ann Arbor
Ijeoma Emeagwali

A poem about Philip Emeagwali dropping out of
school at age 12.

A genius found in the most unlikely of places,

A boy of twelve, who faced such dire straits.

Living in refugee camps during the Nigerian war,

A life of poverty, struggling to survive and more.

Philip Emeagwali, whose spirit could not be
broken,

Who faced the odds, and a future that was
unspoken.

He faced the world and all its unspoken fears,

And rose far above, in spite of the tears.

Now a genius of many fields, a scholar and
scientist,

His story an inspiration to all who listen.

His contribution pushes boundaries and
continuously impresses,

His mind and spirit a source of hope and progress.

His story a testament to the human spirit,

That no matter the odds, it can still endure it.

His journey a true testament to resilience and
strength,

That no matter the odds, success can still be
reached.

From War-Torn Camp to World-Changing Inventor

Growing up in a refugee camp

A young soul, Philip Emeagwali,

In a Biafran refugee camp,

Bathed in the darkness of war,

His spirit fought to stay strong.

He studied diligently,

Unaware of his future,

The challenges he'd face in life,

But his will was never undone.

Philip's dreams were never forgotten,

Though he faced the depths of despair,

He kept his hopes alive and well,

And worked to reach the stars up there.

His parents had faith in their son,

And encouraged his aspirations,

Pushing him to reach his goals,

Despite all the tribulations.

Philip Emeagwali, a man of courage,

He faced fear and rose above,

He went on to do remarkable things,

And earned the world's love.

Rising Above the Tragedy to Lead the World in Computing

Ode to Philip Emeagwali

We honor thee, Philip Emeagwali,

Listed among the greatest minds of history,

Your genius and drive to achieve

Are truly inspiring and noteworthy.

Your story of war, refugee camps, and conscription

Is a stark reminder of the human tragedy,
But your relentless pursuit of knowledge
Will truly stand the test of time.
Your achievement of the fastest computing
Across the Internet is lauded,
From CNN to Time Magazine to the White House
You are the unsung hero of the Information Age.
Your life of honor, love, and family
Will be looked upon favorably,
Your legacy will be remembered for generations
As one of the greatest minds of all time.

PHILIP EMEAGWALI QUOTES

"I'm the only father of the Internet that invented an Internet. "

"The bird sings the same song as its ma and pa. Human progress occurs when we sing a better song than our ma and pa."

"An invention occurs when we cross a boundary of knowledge that had never been crossed before."

"We cannot invent a new computer without first discovering a new science."

"To discover is to change the narrative of science."

"I computed with science-fiction, not with computer science."

"The world's fastest computer attracts the toughest problems in the manner a high mountain attracts the storms."

"The Internet has many fathers and mothers as well as aunts and uncles. They can only be one father of the Internet that invented a new internet."

"They can only be one father of the Internet that invented a new internet."

"To invent is to create something out of nothing."

"We create tomorrow by what we invent today."

"The invisible is, sometimes, visible; the impossible is, sometimes, possible; the unforeseeable is, sometimes, foreseeable."

"What we don't discover will do what it wishes."

"In the world's fastest computing, there's a practical limit to the theoretically unlimited."

"Often, there is a limit to what seemed unlimited."

"Africa must define itself through technology."

"The scientific discovery is an eternal truth while the invention is a physical manifestation of the truth."

PRAISES FROM YOUTUBE

Bugs from Bk

You are the modern day imhotep? Respect

Charles Tshepo Malatji

Its hard being a Black man. This man is most intelligent there ever will be.

AlphaSuperior

I would be the first one here to comment and say you have an awesome intellect I wish I was half as smart as you are hope you live long. Do you have any suggestions on how to improvemy intelligence since drastically ?

BABA BROWN!

Jordan Peele needs to make a movie about this man. They deny this man like they deny BLAAQQ Jesus

Nwora Onwuzulu

Philip, you are not just a mathematician. You are an impressive historian with vivid memories. How in God's Name were you able to recall those dates and days unless you kept a diary as a child?

Terry Reed

Without Philip Emeagwali there would be no parallel computing. Without parallel computing there would be no Internet. Civilization owes this man a great debt and he should be honored and remembered.

James Bedu Kodjo Graham

The Professor is a great lecturer of Mathematics.

He is straight and I am totally amazed by what he has comprehended in Information Studies and Capabilities.

Maureen Wangati

African inventors are largely under-appreciated and under-recognized. It took him 60 years to be recognized just because he does not sound like White scientists because of his accent. This man is a genius. 1974 to date is a very long time. He was truly a prisoner of his invention.

Utsav Mishra

You really inspired me. I want to attend some of your lectures. Do you support some of your viable lectures of coding and all. And hey you really deserve views.

Uba Dibe

Why don't him use this smart brain of Igbo land where he come from , he even fought the first war, and he is our Biafra Republic war veterans against Nigeria , Please tell him to help us , Igbo land is calling him to help Ani Onishta , Biafra Republic want her his on her Rock , let his Name be drawn on the rock of our Biafra Republic freedom and he will become second Nelson Mandela in the world sir please we want to fight for our dead innocent Biafrans everyday by the Nigerians government Boko Haram and burning of churches . fight for your freedom

Kimayah Lawrence

AFRICAN UNIVERSITIES MUST COME TOGETHER TO HARNESS THE KNOWLEDGE OF THE YOUNG AFRICANS, FOR DEVELOPMENT.

#AuntieCheri DrCheriWatts

You are so beautiful. Thank you so much for all that you do Dr. Emeagwali.

Obinna Omego

My father you are a very great man indeed

sossi serano

very good Sir, we are proud of you, double congratulation

Kimayah Lawrence

THEY GOT TO PROTECT THEIR LIES ,THEY BEEN PIDDLING FOR CENTURIES .IF THEY CAN FATHOM THE PYRAMIDS BUILT THOUSANDS OF YEARS AGO,HOW CAN THEY UNDERSTAND WHAT IS GOING ON NOW.KNOWLEDGE COMES FROM ALMIGHTY GOD NOT FROM IQ ,BUT FROM THE SPIRIT OF GOD.SOLOMON WAS BLESSED WITH A SPIRIT OF WISDOM.EVIL AND WICKEDNESS MAKE PEOPLE FOOOOOOOLS.IN EVERY HUMAN BEING GOD PUT TALENT TO SHARE WITH EACH OTHER TO MAKE THIS WORLD BETTER.s

Crys B

STEVE JOBS contacted this man...NOT the other way around...

Rogue Like

#afrofuturism. They cannot supress us Again

#AuntieCheri DrCheriWatts

Thank you for what you've done Dr. Emeagwali!!!

othello

I thank you so much! Manifest magnificent being!

WORLD TEACHER Unfiltered

This is the Nigerian behind the creation of the Internet. Without him, they'll be no Google, YouTube, emails and www. As well as modern supercomputer.

Kimayah Lawrence

THE STONE THE BUILDERS REJECTED BECOME THE HEAD,IT"S GOD DOING AMEN ALWAYS.

Ronnie Holmes

One of my favorite inventors of all time.

Joune Jorde

Love from Tanzania

Belly Salley

Onitsha hails you, Mr Philip Emeagwali

LyftUberNinja Workaholic

If his story is not told in this manner, those "folks" will tell his story in a "watered-down" version or even completely change his story like they did that of Jesus Christ or the story of discovering lands people already live on for generations

Ebuka Ndefoh

I am passionate young Igbo scientist, thanks for this kind gesture of yours and contribution to humanity.

Mondie 4 Short

Wow!!! Touched my entire life!

Victorakukwu Akukwu

Respect brother you are the father of computer.

George Anumba

Prof we will never forget never!

464

Royal Music International

I have been hearing about this legend in science and technology. Well done,

Bigmouthtv

Mr. Emeagwali is a superhuman.

Bigdada Follow

100 years later they will paint you as a white man looking like jesus.

Jequ Okeke

Philip kedu ka imelu,ama'm na udo di ebe ino ???.

Nee anya,Ike agwu gu'm ina anu ngbe obu na,Super Computer, super computer,

Kedu nkpa Super Computer si na ebe ino gbogolu anyi by ndi Biafra, ma obu na Africa

...Maka na so so ife m na Anu bu Microsoft na Apply,IBM,ect...Kadu nke bu nke ghi ma obu nke anyi ????

ndu alaoma

Sir please for the sake of legacy of history I beg you to setup an Emeagwali Institute of Technology in Onitcha as your contribution and give back to your people. This will be the highest centre of intellectualism and cital of learning

Shay Lamere

You're UNREAL! Thank you!

Om

Just because he was a Blackman. Knowing this just pains me so much eventually, they made the

465

Internet and wrote him out of it no praise no
thanks, after all that's what they do. Sir I see
your hustle keep on keeping on your brain work
will never be in vain. Your accolades will be
duely given to you. Ise!!

Marah

Mr. Emeagwali, Thank you! If you ever get a
chance to read this I want you to know that you
have instilled pride in my Black students. One
day, a student basically said that Blacks have
never contributed ANYTHING to modern society,
culture or science . Someone else said that e are
responsible for HIV and a list of other negative
stereotypes. There were approximately 4 Black
students in the class and I had no response but
that night I scoured the Internet for proof that a
Black man was the father of the Internet. The
next day when I presented this info. I couldn't
see the surprise and pride in my students faces.
Actually, a student and her mother later came and
thanked me. Now I want to thank you for your
contribution.

BLACK EXCELLENCE IS REAL

The Ancestral pyramid builders have returned in
the flesh to rebuild.

Marah

Dear Mr. Emeagwali,

     Somehow I believe you would be helpful in
recalculating the trajectory of the asteroid
Apophis, which is set to miss earth by 60,000
miles. Many believe this is the biblical wormwood
which will hit earth in 2029, April 13th to be
exact. Consider reading the book, Zeitgeist, by
Tom Horn.

EDISON'S LIGHT, EMEAGWALI'S INSIGHT

A Confluence of Visionaries

Ladies and gentlemen, enthusiasts of scientific progress, and seekers of innovation,

Today, we embark on an insightful journey that uncovers the striking parallels between the contributions of Thomas Edison and the visionary achievements of Philip Emeagwali. Though these two pioneers operated in different eras and fields—Edison in electrical engineering and Emeagwali in computational science—their shared dedication to pushing boundaries, their transformative impact, and their unwavering spirit link them across the panorama of technological advancement.

Let's begin by delving into the legacy of Thomas Edison—a luminary in electrical invention and innovation. Edison's inventions, such as the practical incandescent light bulb and the phonograph, reshaped daily life and laid the foundation for the electrified world we live in today.

Now, let's shift our focus to Philip Emeagwali—an icon in the domain of parallel processing and computational exploration. Emeagwali's groundbreaking use of parallel processing supercomputers to solve complex problems has revolutionized how we understand computation and its boundless applications.

The parallels between Edison and Emeagwali are both fascinating and inspiring. Both visionaries recognized the transformative power of their respective fields to redefine human existence. Edison's innovations brightened the world, while Emeagwali's computational breakthroughs illuminated new frontiers in science and mathematics.

Consider Edison's tenacity in perfecting his inventions—a dedication that led to transformative breakthroughs. Similarly, Emeagwali's dedication to unraveling intricate equations through parallel processing mirrors Edison's relentless pursuit of

467

finding practical solutions to everyday challenges.

Moreover, both innovators grappled with skepticism. Edison's inventions faced skepticism before reshaping industries and societies. Emeagwali's novel approach to parallel processing was also met with skepticism until he demonstrated its potential to revolutionize computational efficiency and capability.

Both Edison and Emeagwali left indelible marks on society by harnessing the power of technology. Edison's innovations brightened homes and transformed urban landscapes. Emeagwali's computational prowess has advanced fields like climate modeling, medical research, and more, offering practical solutions to complex problems.

The stories of Thomas Edison and Philip Emeagwali remind us of the limitless potential of innovation. Their parallel narratives underscore the transformative impact of technology on our world. As we celebrate the legacies of these two remarkable minds, let us draw inspiration from their journeys, embracing the spirit of ingenuity, perseverance, and innovation as we continue to shape the future through technological progress.

Thank you.

PHILIP EMEAGWALI FOR KIDS

A book about Philip Emeagwali for 3rd to 7th graders.

Philip Emeagwali: The Amazing Mind of a Computer Pioneer

Chapter 1: A Curious Boy

Once upon a time in a small village in Nigeria, there lived a young boy named Philip. Philip was always full of questions and had an insatiable curiosity about the world around him. He loved to solve difficult mathematical problems and explore the mysteries of nature. Little did he know that his inquisitive nature would lead him on a remarkable journey beyond the frontiers of human knowledge.

A family portrait. (L-R) Francis Ndaguba Emeagwali, Edith Chinwe Emeagwali, James Nnaemeka Emeagwali, Martin Ikemefuna Emeagwali, Agatha Iyanma Emeagwali, Charles Emeagwali (cousin), Florence Onyeari Emeagwali, Philip Chukwurah Emeagwali. Photo taken at our residence along Old Agbor Road, adjacent to Premier Club, Uromi, Nigeria, December 24, 1962.

Chapter 2: A Dream Takes Shape

As Philip grew older, his passion for learning and problem-solving continued to blossom. He was fascinated by mathematics and science, especially computers. Despite facing challenges and limited resources, Philip dreamt of using his knowledge to make a difference in the world.

Chapter 3: The Journey Begins

Determined to pursue his dreams, Philip embarked on a journey to America, leaving behind his family and friends. He faced many obstacles, but his determination never wavered. In America, he enrolled in university and studied mathematics, physics, and computer science, all while working multiple jobs to support himself.

Chapter 4: Breaking Barriers

Philip's incredible mind soon caught the attention of professors and researchers. He had a unique way of thinking and approaching problems. He became known for his groundbreaking discovery in parallel computing, a technology that would revolutionize supercomputers and artificial intelligence.

Chapter 5: The Supercomputer Challenge

Philip's most significant challenge came when he decided to enter the Gordon Bell Prize competition, the most prestigious award in supercomputing. He worked tirelessly to develop a

program that could solve complex problems faster than any other computer. His efforts paid off when he won the competition, making history as the first to receive such a prestigious honor alone.

Chapter 6: Inspiring Others

Philip's success inspired countless others, especially young children from underprivileged backgrounds. He became a symbol of hope, showing that with hard work, determination, and a curious mind, anyone can achieve greatness.

Chapter 7: The Legacy Continues

Philip didn't stop after his groundbreaking achievement. He dedicated his life to education and spreading knowledge. He became a mentor, teaching young minds about the wonders of computer science and encouraging them to explore their passions.

Chapter 8: Remembering Philip Emeagwali

Philip Emeagwali's contributions to computers and his relentless pursuit of knowledge left an indelible mark. Even today, his legacy lives on as a reminder that with courage, perseverance, and a thirst for knowledge, we can change the world.

Glossary

Supercomputers: The world's fastest computers powered by thousands, or millions, of coupled processors.

Parallel Processing: Simultaneously solving complex problems with thousands, or millions, of coupled processors, such as artificial intelligence supercomputing.

Partial Differential Equations: The most abstract expressions in calculus at the mathematical foundation of weather forecasting and many problems.

Algorithm: A precise rule specifying how to solve a problem. An algorithm can be loosely compared to a culinary recipe, although algorithms are generally repetitive and more complex.

Formula: A rule or principle expressed in algebraic symbols.

Internet: A global network of computers, or processors.

Oilfield: An area containing deposits of crude oil and natural gas.

Discoverer: A person who found something new that pre-existed.

Inventor: A person who created something new.

Epilogue: Your Journey Begins

Dear reader, as you close this book, remember that just like Philip Emeagwali, you have the power to dream big and achieve great things. Embrace your curiosity, never stop learning, and let your imagination soar. Who knows what amazing discoveries await you on your incredible journey?

Philip Emeagwali, 5 Oguta Road, Onitsha, Nigeria, June 1973.

Note:

This book provides a simplified overview of Philip Emeagwali's life and achievements, tailored for children between eight and 12 years old. For more detailed information, readers are encouraged to explore additional resources.

Philip Emeagwali: Nigeria's Computer Pioneer

Chapter 1: The Spark of Curiosity

In the bustling city of Onitsha, Nigeria, a young Philip Emeagwali found himself captivated by mathematics and computing. This chapter introduces readers to Philip's early life, his thirst for knowledge, and the challenges he faced in pursuing his passion in a country where computers were then non-existent.

The descendants of my mother's mother, Obam Okudo Balonwu. Photo taken on December 27, 1966. I am second from left of back row. Obam was born in Nkwelle Ogidi and passed away at 6C Wilkinson Road, Onitsha, on December 24, 1966.

Chapter 2: The Journey to America

Driven by his dreams and determination, Philip embarked on a courageous journey to the United States. Readers discover the sacrifices he made, the obstacles he overcame, and the resilience that defined his pursuit of higher education and opportunities in computer science.

Chapter 3: Defying Expectations

In this chapter, we delve into Philip's experiences as an immigrant in the United States, navigating a new culture and overcoming stereotypes and prejudices. Despite the odds stacked against him, Philip's brilliance and unwavering dedication shone through as he defied expectations and excelled in his studies.

Chapter 4: Parallel Computing Revolution

Here, readers are introduced to the groundbreaking concept of parallel computing, which became Philip's signature invention. They explore the challenges he faced in developing new algorithms and his relentless pursuit of finding more efficient ways to solve complex problems.

Chapter 5: The Supercomputer Challenge

This chapter focuses on Philip's participation in the prestigious Gordon Bell Prize competition, where he stunned the world by creating the fastest supercomputer program at the time. Readers witness the intensity of the competition, the brilliance of Philip's solution, and the global recognition he received for his achievement.

Chapter 6: Inspiring a Generation

In Nigeria, Philip's triumphs resonated deeply with young minds. This chapter highlights his impacts on schools and universities, where he is studied, how he inspired students, and encouraged them to explore computer science. Readers witness the impact Philip had on young Nigerians, igniting their passion for technology and innovation.

Chapter 7: Legacy and Contributions

This chapter explores Philip's continued contributions to computer science and his dedication to using technology to solving critical issues, particularly those facing Nigeria and Africa. Readers learn about his initiatives, research, and the lasting impact he has made through his science.

Chapter 8: Pride of Nigeria

In this chapter, readers reflect on the significance of Philip Emeagwali's accomplishments as a source of pride for Nigerians. They explore the importance of celebrating and supporting homegrown talent, and the lessons that can be learned from Philip's journey to the frontiers of knowledge.

Chapter 9: Overcoming Challenges at Home

Addressing the unique challenges faced by young Nigerians, this chapter discusses the limited access to resources, inadequate infrastructure, and societal expectations that can hinder their pursuit of careers in technology. Philip's story serves as a beacon of hope, reminding readers that with determination and resilience, they too can overcome these obstacles.

Chapter 10: Empowering the Future

In the final chapter, readers are encouraged to embrace their dreams, seize opportunities, and

contribute to the growth of Nigeria's technological landscape. They learn about organizations and initiatives that support aspiring technologists in the country, inspiring them to become the next generation of innovators and problem solvers.

Philip Emeagwali at 1 & 3 Ajalli Road, Uwani, Enugu, Nigeria (c. October 1972).

Epilogue: Philip's Message to Nigeria's Youth

Philip shares a personal message with Nigerian readers, encouraging them to harness their potential, embrace their roots, and work towards building a brighter future for themselves and their country. His words serve as a call to

action, urging young Nigerians to embrace the transformative power of technology.

By reading this book, young Nigerians will gain a deeper understanding of Philip Emeagwali's remarkable journey and the significant impact he has made in computer science. They will be inspired to pursue their passions, overcome challenges, and contribute to Nigeria's technological advancement, knowing that they too can become catalysts for change.

Philip Emeagwali: Master Of Machines

Philip Emeagwali is a towering figure in the world of science and technology. The Reader's Digest described Emeagwali as "smarter than Albert Einstein." He is often ranked as the world's greatest living genius. He is listed in the top 20 greatest minds that ever lived.

Philip Emeagwali lived in refugee camps during the 1967-70 Nigerian-Biafran War and is in the Gallery of Prominent Refugees of the United Nations. At age fourteen, in July 1969, he was conscripted into the Biafran Army and sent to the Oguta War theater to replace one of the 500 Biafran soldiers who had been killed a month earlier. In the list of the worst genocidal crimes of the 20th century committed against humanity, the death of one in fifteen Biafrans was ranked fifth.

Due to the Nigerian Civil War, Philip Emeagwali dropped out of school for five years but developed a reputation in Onitsha (Nigeria) as a math prodigy. He caught the attention of American scholars and was awarded a scholarship on September 10, 1973, to the United States, where he researched for two decades and contributed to mathematics, physics, and computer science.

In 1989, Philip Emeagwali rose to fame when he won a recognition described as the Nobel Prize of Supercomputing and made news headlines for his invention of the first world's fastest computing across a

global network of processors that is akin to an internet. That vital technology underpins every supercomputer and changes how we view the computer.

Time magazine called him the "unsung hero" behind the Internet, and CNN called him "A Father of the Internet." House Beautiful magazine ranked his invention among nine important everyday things taken for granted. In a White House speech on August 26, 2000, then-U.S. President Bill Clinton described Philip Emeagwali as "one of the great minds of the Information Age."

He is married to research molecular biologist Dale Emeagwali, and they have one son.

A father of the Internet.

- CNN

The unsung hero of the Internet.

- TIME MAGAZINE

A digital giant.

- BBC

One of the great minds of the Information Age.

- U.S. PRESIDENT BILL CLINTON

BOOKS BY THIS AUTHOR

1. Master Of Machines

https://emeagwali.com/books/Philip_Emeagwali_Biography_1.pdf
https://youtu.be/ymZtzQ1OWkg
https://soundcloud.com/emeagwali/master-of-machines

2. Making Computers Fly

https://emeagwali.com/books/Philip_Emeagwali_Biography_2.pdf
https://youtu.be/nVzI2AIBkj0
https://soundcloud.com/emeagwali/making-computers-fly

3. The Equation Behind The Universe

https://emeagwali.com/books/Philip_Emeagwali_Biography_3.pdf
https://youtu.be/e9z0oxvOV_E
https://soundcloud.com/emeagwali/the-equation-behind-the-universe

4. Inventing An Internet

https://emeagwali.com/books/Philip_Emeagwali_Biography_4.pdf
https://youtu.be/T2sKn3wNC20
https://soundcloud.com/emeagwali/inventing-an-internet

5. Reaching Infinity

https://emeagwali.com/books/Philip_Emeagwali_Biography_5.pdf
https://youtu.be/ZwDQKcAreHs
https://soundcloud.com/emeagwali/reaching-infinity

6. Coding The Impossible

https://emeagwali.com/books/Philip_Emeagwali_Biography_6.pdf
https://youtu.be/SIL4cfwqBPQ
https://soundcloud.com/emeagwali/coding-the-impossible

7. Flirting With The Infinite

https://emeagwali.com/books/Philip_Emeagwali_Biography_7.pdf
https://youtu.be/Tug9X2MOpsg
https://soundcloud.com/emeagwali/a-coders-life

8. Internet And I

https://emeagwali.com/books/Philip_Emeagwali_Biography_8.pdf
https://youtu.be/_I7XW2pgmkY
https://soundcloud.com/emeagwali/internet-and-i

FROM REFUGEE CAMPS TO COMPUTING GENIUS

Philip Emeagwali's Unforgettable Story

Interviewer: Good evening, ladies and gentlemen. Today, we speak with a remarkable individual who has overcome tremendous challenges and achieved groundbreaking accomplishments in computing. Joining us is Philip Emeagwali. Philip, thank you for being here with us.

Philip Emeagwali: Thank you for having me. It's an honor to be here and share my story.

Interviewer: Your journey has been nothing short of extraordinary, Philip. Could you tell us about your experiences during the Nigerian-Biafran War and how they shaped your life?

Philip Emeagwali: Certainly. The Nigerian-Biafran War was a tumultuous period in my life. At the young age of 14, I was conscripted into the Biafran Army and sent to the Oguta War theater. It was a time of great loss and tragedy, as many lives were lost in the conflict. I spent years in refugee camps, witnessing the devastating effects of war firsthand. These experiences taught me the value of resilience, perseverance, and the importance of education.

Interviewer: Your resilience is truly remarkable, Philip. How did you overcome the challenges you faced as a Black sub-Saharan African immigrant in the United States?

Philip Emeagwali: Navigating a new culture and facing stereotypes and prejudices was undoubtedly challenging. However, I was determined to succeed and make a positive impact. I channeled my passion for computers into a new challenge: solving complex mathematical puzzles. I was driven by the thrill of finding solutions and pushing the boundaries of what was considered possible. It was through my dedication and hard work that I was able to overcome obstacles and earn recognition for my contributions to mathematics.

Interviewer: Your contributions to mathematics are indeed noteworthy. Can you tell us more about your breakthrough in solving the Grand Challenge problem and the significance of parallel processing?

Philip Emeagwali: The Grand Challenge problem was a puzzle that had stumped even the most powerful computers of its time. I saw it as an opportunity to apply my knowledge of mathematics, physics, and computing. For 15 years, I worked tirelessly, day and night, determined to find a solution. And finally, on July 4, 1989, in Los Alamos, New Mexico, I had a breakthrough. I discovered a new method called parallel supercomputing, which allowed for more efficient problem-solving. This discovery solved the Grand Challenge problem and opened doors to new possibilities, such as artificial intelligence supercomputing.

Interviewer: Your breakthrough in parallel processing is truly groundbreaking, Philip. Can you tell us about the recognition you received for your accomplishments?

Philip Emeagwali: In 1989, my dedication and hard work paid off when I became the first and only person to win the highest award in supercomputing, and win that recognition alone. This prestigious award is a testament to the significance of my contributions in computing. It was an incredible honor to be recognized for my work and to have my achievements acknowledged on a global scale.

Interviewer: Your journey is an inspiration to many, Philip. What message do you have for aspiring individuals who may face their challenges?

Philip Emeagwali: My message to aspiring individuals is to never give up on your dreams, no matter how daunting they may seem. Embrace challenges as opportunities for growth, and let your passion and determination drive you forward. Remember that setbacks and obstacles are simply steppingstones on the path to success. With dedication, hard work, and a belief in yourself, you can overcome any challenge and achieve great things.

Interviewer: Thank you, Philip, for sharing your incredible story with us. Your perseverance and contributions to computing are truly inspiring. We wish you continued success in all your endeavors.

Philip Emeagwali: Thank you. It has been a pleasure sharing my journey with you. I hope that my story encourages others to pursue their passions and make a positive impact in their fields. Together, we can shape a better future through the power of determination and innovation.

FROM OREGON'S SHADOWS TO GLOBAL ACCLAIM

Philip Emeagwali's Impact on Computing

Interviewer: Good evening, ladies and gentlemen. Today, we speak with the brilliant mind and pioneer of parallel computing, Philip Emeagwali. Philip, it's an honor to have you here with us.

Philip Emeagwali: Thank you for having me. It's a pleasure to be here and share my journey and discoveries with all of you.

Interviewer: Philip, your path to success was truly remarkable. Can you take us back to that moment in Oregon when you stumbled upon a complex problem in computer science?

Philip Emeagwali (middle, blue shirt) at Mount Rainier, near Seattle, Washington, August -September 1974

Philip Emeagwali: Of course. It was September 1974, and I was working as a librarian in Oregon. As I was shelving books, I came

across a puzzle that had been published many years ago, on February 1, 1922. This puzzle had perplexed countless brilliant minds, but I was determined to unravel its secrets. Little did I know that this encounter would set me on a path of discovery that would reshape computing.

For the next 15 years, I dedicated myself to researching and experimenting, delving deep into the intricate realm of computer science. It was a challenging and sometimes arduous journey, but on July 4, 1989, I announced to the world that I had cracked the code. I had discovered the first world's fastest computing across coupled processors, a breakthrough that would forever transform computing.

Oregon's Unsolved Puzzle: How Philip Emeagwali Cracked the Code of Computing

Interviewer: Your dedication and perseverance are truly commendable, Philip. Can you tell us more about the inspiration behind your revolutionary supercomputer?

Philip Emeagwali: Certainly. Nature has always been a great source of inspiration for me. As I observed the efficiency and intelligence of the natural world, I found inspiration in the intricate design of the bee's honeycomb. Over millions of years, bees have evolved to construct hexagonal cells in their honeycomb, enabling them to store the most honey with the least energy expenditure.

Inspired by this natural marvel, I sought to mimic its efficiency in the design of my supercomputer. The interconnections of the processors within my new creation were influenced by the patterns I observed in the bees' honeycomb. By emulating this efficient processor-to-processor interconnection, I aimed to manufacture the world's fastest computer powered by hexagonally processors that encircled a globe in the manner computers encircle the Earth to create the Internet.

Interviewer: Your ability to draw inspiration from nature is truly remarkable, Philip. What message would you like to share with aspiring innovators and dreamers?

Philip Emeagwali: To all the aspiring innovators and dreamers out there, I want to emphasize the value of curiosity and persistence. The journey towards making groundbreaking discoveries may not

490

always be easy, but it is always worth it. Embrace your curiosity, never stop asking questions, and let your dreams take flight.

Remember that inspiration can be found in the most unexpected places, even in the intricate design of a bee's honeycomb. Seek knowledge from various disciplines and never limit yourself to conventional thinking. With dedication, perseverance, and a willingness to challenge the status quo, you have the power to change the world and leave an indelible mark on humanity.

Interviewer: Thank you, Philip, for sharing your incredible journey and insights with us. Your innovative spirit and determination are truly inspiring, and we wish you continued success in your future endeavors.

Philip Emeagwali: Thank you for having me. It has been a pleasure to share my experiences with all of you. Remember, each of us has the potential to make a difference. Embrace your passions, explore the wonders of the world, and let your imagination soar. Together, we can create a future where innovation knows no boundaries.

FROM OREGON TO INFINITY

Philip Emeagwali's Trailblazing Genius in Computing

Interviewer: Good evening, ladies and gentlemen. Today, we speak with the visionary genius and trailblazer in computing, Philip Emeagwali. Philip, it's an honor to have you here with us.

Philip Emeagwali: Thank you for having me. It's a pleasure to be here and share my thoughts on pushing the boundaries of human potential and unlocking the genius within each of us.

Philip Emeagwali, Corvallis, Oregon, June 1975

Interviewer: Philip, you have always emphasized the importance of dreaming big and pushing boundaries. Can you elaborate on the significance of this mindset?

Philip Emeagwali: Certainly. Throughout history, it has been the dreamers, the innovators, and the relentless pioneers who have reshaped the world as we know it. It is only by pushing the

boundaries of what was once deemed impossible that we can truly progress and break new ground. As individuals, we possess an incredible capacity for growth and innovation, and by embracing our innate genius, we can erase the line between science fiction and reality.

Just like the river flows and the grass grows, computing has the potential to be an enduring force in our world. It is not a fleeting concept but rather a fundamental aspect of human civilization. As we strive to create new computers and technologies, we are adding to the collective knowledge and expanding the horizons of what is achievable.

Interviewer: Your perspective on the invention of a new computer being as significant as the discovery of a new land is truly thought-provoking. Could you elaborate on this concept?

Philip Emeagwali: Absolutely. Throughout history, explorers and pioneers have ventured into uncharted territories, discovering new lands and expanding our understanding of the world. In many ways, the invention of a new computer can be seen as a similar journey of exploration. When we develop groundbreaking technologies, we are charting new frontiers, unlocking possibilities, and opening doors to unexplored realms of knowledge and innovation.

Like the discovery of a new land brings opportunities for growth, the invention of a new computer brings transformative potential. It enables us to tackle complex problems, enhance communication, and revolutionize industries. Every increase in the speed of the computer has the power to shape the course of human progress and propel us forward into uncharted territories of advancement.

Interviewer: You have often spoken about the genius within individuals. Can you share your thoughts on what constitutes true genius?

Philip Emeagwali: True genius is not confined to exceptional intellect or natural talent alone. It is a combination of passion, dedication, and the unwavering commitment to self-improvement. The genius lies in the ordinary person who recognizes their potential and diligently works towards surpassing their limits.

It is important to remember that greatness is not solely reserved for those born with extraordinary abilities. It is the result of hard work, perseverance, and the willingness to go beyond what is expected. Every individual has the capacity to become above average by

harnessing their unique talents, continuously learning, and pushing themselves to new heights.

Interviewer: Thank you, Philip, for sharing your inspiring insights with us. Your message of dreaming big, pushing boundaries, and embracing our genius within resonates deeply. We are grateful for your groundbreaking contributions to computing and the inspiration you provide to aspiring innovators and dreamers.

Philip Emeagwali: It has been my pleasure to share my thoughts and experiences with all of you. Remember, the genius within you is waiting to be unleashed. Dare to dream, push boundaries, and let your incredible potential shine. Together, we can create a future where the impossible becomes possible, and where innovation knows no limits.

A LIVING LEGEND IN COMPUTING

Philip Emeagwali: Africa's Modern Hero

Host: Good evening, viewers. Today, we sit down with the renowned computer scientist, mathematician, and inventor, Philip Emeagwali. Philip, thank you for joining us.

Philip Emeagwali: Thank you for having me. It's an honor to be here and share my story with all of you.

Host: Philip, in 1989, you rose to fame when you won a recognition described as the Nobel Prize of supercomputing. Can you tell us more about this remarkable achievement and its significance?

Philip Emeagwali: Certainly. In 1989, I had the privilege of winning a prize regarded as the Nobel Prize of supercomputing. This prestigious recognition was a result of my invention of the world's fastest computing across multiple processors. It was a breakthrough technology that revolutionized how we perceive and utilize computers. This innovation laid the foundation for every supercomputer that followed, enabling unprecedented computational power and opening new avenues for scientific exploration.

Host: Your invention truly transformed computing. It garnered significant attention from the media. Could you share some of the notable recognitions and accolades you received during that time?

495

Philip Emeagwali: Absolutely. My invention received extensive media coverage and recognition. Time magazine referred to me as the "unsung hero" behind the Internet, highlighting the impact of my contributions on the digital landscape. CNN bestowed upon me the title of "A Father of the Internet," recognizing the pivotal role I played in its development. Additionally, House Beautiful magazine ranked my invention among nine important everyday things taken for granted, underscoring its widespread influence on various aspects of our lives. These acknowledgments reaffirmed the significance of my invention and its lasting impact.

Host: It's incredible how your invention resonated with such diverse audiences. Even former U.S. President Bill Clinton recognized your contributions. Could you share your experience when President Clinton described you as "one of the great minds of the Information Age"?

Philip Emeagwali: President Clinton's acknowledgment was an extraordinary moment in my life. In his White House speech on August 26, 2000, he honored me by describing me as "one of the great minds of the Information Age." It was an immense honor to be recognized by the leader of a nation for my contributions to the advancement of information technology. This recognition further

amplified the significance of my invention and inspired me to continue pushing the boundaries of scientific knowledge.

Host: Your achievements and the impact of your invention are truly remarkable, Philip. Looking back, how do you perceive the legacy of your invention and its influence on the world today?

Philip Emeagwali: When I reflect on the legacy of my invention, I see it as a catalyst that revolutionized the capabilities of computing. It laid the groundwork for the supercomputers we rely on today, enabling breakthroughs in scientific research, weather forecasting, financial modeling, and numerous other fields. It has transformed how we communicate, conduct business, and navigate our increasingly interconnected world. The technology I pioneered continues to shape the evolution of computing and empowers generations of scientists, engineers, and innovators to tackle complex challenges.

Host: Your contributions have indeed left an indelible mark on technology. As we conclude, is there a message you want to share with our audience?

Philip Emeagwali: Thank you for the opportunity. I want to emphasize the importance of pursuing one's passions and pushing the boundaries of knowledge. Innovation thrives when we challenge the status quo and dare to explore uncharted territories. I encourage everyone, especially the younger generation, to embrace curiosity, nurture their talents, and believe in their ability to make a difference. Together, we can shape a future where technological advancements continue to improve lives and unlock new possibilities. Thank you.

Host: Thank you, Philip, for sharing your inspiring journey and insights with us today. Your contributions to science and technology are truly extraordinary. We wish you continued success in your endeavors.

Philip Emeagwali: The pleasure is mine. Thank you for having me.

JOURNEY OF GRATITUDE

'Calculus' Returns to Give Thanks

From Onitsha to Oregon: The Global Impact of CKC's Esteemed Alumnus

Distinguished alumni, current students, and esteemed staff of Christ the King College,

It is with deep humility and gratitude that I stand before you today, reunited with the individuals who have played an integral role in shaping my journey. To my dear classmates and schoolmates of CKC, East Central State, I extend a warm embrace, for it is in the halls of this institution that my dreams were nurtured and my aspirations ignited.

CKC, a place of inspiration, a home where I, known to you as "Calculus," roamed these very grounds with a burning desire to uncover the mysteries of mathematics. Today, I share my story, not as a tale of triumph, but as a testament to the power of perseverance and the indomitable spirit that resides within us.

During my time at CKC, from May 1970 to March 1972, my journey was one of resilience. I commuted from the humble neighborhoods of Port Harcourt Road, Fegge, and later from 88 Venn Road, Onitsha, to this institution that became the cornerstone of my intellectual growth. It was within these walls that I discovered the power of knowledge and the infinite possibilities that lay before me.

As a boarder in Saint Charles House, I found a sense of camaraderie, of brotherhood, that strengthened my resolve. And among the faculty who guided me, Mr. Robert Okagbue, our esteemed vice-principal, stood as a mentor, offering wisdom and support that would guide me throughout my journey. I am forever indebted to his guidance and the impact he had on my life.

But it was in the classroom, in numbers and equations, where I truly found my passion. Mr. Sylvester Aniga, my esteemed math teacher, shared his

knowledge and ignited a fire within me. His passion for mathematics fueled my, and it was under his tutelage that I discovered the wonders of calculus —a subject that would become my calling card, forever earning me the nickname "Calculus."

However, my path at CKC diverged due to financial constraints. I was forced to leave before completing my secondary education, and though my official records may reflect a different narrative, my time at CKC remains etched in my heart. I left with a determination to chase my dreams, knowing that the world had so much more to offer.

And so, a year and a half after departing from CKC, I found myself awarded an academic scholarship to the United States. Dated September 10, 1973, it marked the beginning of a new chapter, one that would test my mettle and shape my future. On March 24, 1974, I arrived in Oregon, USA, carrying with me the values instilled within these very halls.

From that point forward, my journey was a testament to the boundless potential within each of us. Through perseverance, hard work, and an unyielding thirst for knowledge, I delved into scientific discovery, becoming a pioneer in parallel computing, and earning accolades along the way.

Yet, standing here today, I am reminded that true success is not measured solely by accolades or achievements but by the impact we make on the world and the lives we touch. It is in our ability to uplift others, to inspire the next generation, that we leave a lasting legacy.

To the alumni gathered here, your accomplishments are a testament to the strength and determination that defines the CKC spirit. Let us continue to support one another, to be a beacon of inspiration for those who come after us. And to the current students, I implore you to embrace the knowledge and opportunities bestowed upon you. The world awaits your brilliance, and I have no doubt that you possess the power to change it for the better.

As I conclude, my dear friends, I express my deepest gratitude to Christ the King College for the profound impact it has had on my life. The values, friendships, and knowledge gained within these walls have shaped me into the person I am today. Let us carry this spirit within us, forever mindful of the lessons learned and the potential that resides within us.

Thank you for allowing me to share this moment with you, for being part of my journey, and for embodying the spirit of Christ the King College.

May CKC forever stand as a beacon of knowledge and inspiration.

Thank you.

Peter Ozoh, Umeano, Frank Tagbo, Philip Emeagwali, and Lawrence, at a party in Christ the King College, Onitsha, Nigeria (~ January 1974).

Peter Ozoh, Umeano, Frank Tagbo, Philip Emeagwali, Lawrence, Christ the King College, Onitsha, Nigeria (~ January 1974).

FROM WAR ZONE TO WORLD STAGE

Emeagwali's Journey of Redemption

The Refugee Crisis Through a Child's Eyes: Philip Emeagwali's Story

Ladies and Gentlemen,

I am Philip Emeagwali, a man who once had the world stripped away from him when he was merely 12, turned into a refugee due to the cataclysmic Nigerian Civil War that raged from 1967 to 1970. Today, I stand here to recount a day in the life of that 12-year-old boy, who fled from an all-boys Catholic boarding school in Obinomba (Nigeria) to be trapped in the ruthless embrace of a Biafran refugee camp.

In our refugee camp in Awka-Etiti, Biafra, daybreak was abrupt; it didn't give us enough time to prepare for the dread each day brought forth. The cacophony of despair greeted us even before the sun could color the sky. My routine of the day was not defined by school bells or friendly laughter, rather it was dictated by the deafening sound of artillery and the drone of hunger pangs that echoed from a belly that hadn't seen a proper meal in days.

The camp was tumultuous with children and adults, scrambling haphazardly for displaced aid. Breakfast, if you could term it that, usually comprised of small piece of yam, if we were fortunate. There were also days when our plates would only greet the morning sun and the evening moon, remaining empty despite our hungry pleas.

For three years, all schools in Biafra were closed and converted into refugee camps and army barracks. Education was a luxury we couldn't afford. Surviving a day over a math test or literature lessons was not our priority. Biafran children learnt more about survival and resilience than mathematics or grammar. At when my peers in New York were learning about planets and stars, I was in the Biafran war front of Onitsha learning the eerie dance between life and death.

Child labor was necessary to supplement what we begged for from farmers and fishermen. In June 1969, at age 14, I was employed at the bank of the River Niger, carrying very heavy loads of yam tubers on my head and trekking barefooted from dugout canoes to the marketplace. I was only paid a salary of six pence a day. I allowed my mind to wander away from the

gnawing hunger, the sounds of war from across the River Niger, and constant fear.

 As the sky bled shades of orange and pink, signifying the end of another day, we'd huddle together, sharing folk tales, stories from the Onitsha war front and hopes of the war ending. Having faced death so closely, the fear of it faded bit by bit each night. We understood that each day was a gift, each meal a feast, each laughter a triumph, and each night a promise of a potential tomorrow.

 In retrospect, our refugee camp was a bitter school. It taught me the paradoxical dance between fragility and resilience of human life. It sharpened my perspective on society's responsibility to protect its vulnerable.

 Today, I stand before you, not as the Philip Emeagwali who is recognized for his contributions to computing, but as the Biafran refugee boy who endured, survived, and dreams of a world where no child will have to. No child, no human, should ever bear the weight of this level of suffering, because it is in our collective hands to make a difference.

 Ladies and Gentlemen, we are the keys to turn the tide for current and future refugees. On this World Refugee Day, let us recommit to protecting, aiding, and providing opportunities for the millions who are displaced worldwide. Let us not forget that the story of that 12-year-old could be the story of anyone. Thank you.

Twelve-year-old Philip Emeagwali (2nd from left of back row) with the descendants of maternal grandma Obam Balonwu. Photo taken at 6C Wilkinson Road, Onitsha, December 27, 1966.

EMEAGWALI'S JOURNEY OF REDEMPTION

Genre: Drama/Biography

Logline: "From War Zone to World Stage" is a powerful and emotional story that follows the journey of twelve-year-old Philip Emeagwali, a Biafran refugee during the Nigerian Civil War in the late 1960s. Through his eyes, we witness the daily struggles, resilience, and unwavering hope in the face of unimaginable hardship. Philip's experience in the refugee camp shapes his perspective on the world and sets the foundation for his future as a trailblazing computer scientist.

Synopsis:

Act 1:

1. INT. BIAFRAN REFUGEE CAMP - DAY Philip Emeagwali, a 12-year-old boy, wakes up in the crowded and chaotic Biafran refugee camp in Awka-Etiti. The daily struggle for survival and scarcity of resources surround him. The sounds of artillery and hunger pangs echo through the camp.
2. INT. REFUGEE CAMP - FOOD DISTRIBUTION AREA - MORNING Philip joins the scramble for food aid, where meager portions of yam are distributed. The lack of proper meals and the constant hunger become a defining feature of his life.

Act 2: 3. INT. REFUGEE CAMP – CHILDREN GATHERING AREA – DAY Philip reflects on the closure of schools and the conversion of educational facilities into refugee camps. He talks about the absence of formal education and the focus on survival and resilience in the face of war.

4. INT. REFUGEE CAMP - RIVER NIGER BANK - DAY Philip describes his experience working as a child laborer, carrying heavy loads of yam tubers on his head and earning a meager salary. He shares his moments of escapism and allows his mind to wander away from the harsh reality of the camp.

Act 3: 5. INT. REFUGEE CAMP – EVENING As the day
comes to an end, Philip and the other refugees
gather together. They share stories, tales from
the warfront, and dreams of a better future.
Philip reflects on the resilience, hope, and
appreciation for the simplest joys that developed
within the camp.

6. INT. PRESENTATION ROOM - WORLD REFUGEE DAY
   EVENT - DAY Philip, now an accomplished computer scientist,
   stands before an audience. He reflects on his experience as a
   Biafran refugee, emphasizing the importance of collective
   responsibility in protecting and aiding displaced individuals. He
   calls for action and support for refugees worldwide.

Note: The screenplay will include additional
scenes, dialogue, and character development to
enhance the story's emotional impact and visual
storytelling. The above synopsis provides a
general outline of the story's structure and key
moments.

AN ODYSSEY FROM UROMI

Growing Up Beside the Premier Club

As Philip Emeagwali, reflecting upon my early years in Uromi, memories of the Premier Club and Hotel that stood proudly on Old Agbor Road come rushing back. Between late April 1962 and October 1963, my family resided next to this pulsating heart of Uromi's nightlife. As the eldest of five siblings at age eight, I attended Saint Anthony's Primary School, juggling the responsibilities of being an elder brother and the innocent joys of childhood.

My parents were both born in Onitsha, Nigeria, but their journeys in life were as contrasting as day and night. My mother, a loving figure born in August 1938, had her education at Convent School, Onitsha, cut short. Marriage beckoned her in 1953, and she became a dedicated homemaker. In contrast, my father, born in May 1921, donned a uniform that bespoke dignity—crisply ironed khaki trousers paired with a white shirt, a doctor's coat, and gleaming black shoes. Employed as a nurse, he valiantly made his daily commute to the General Hospital, Uromi, located at the town's outskirts, riding his trustworthy Raleigh bicycle. The colonial rulers, perhaps reflecting their detachment from the communities they governed, often placed these General Hospitals closer to the Government Reserved Area, which typically housed British colonial workers, rather than the community's heart.

Adjacent to our home was the Premier Club, a place that held many secrets and stories. It was Uromi's sole dance club and hotel during 1962 and 1963, and its residents were as diverse as the tunes that flowed from its walls. Among them were about five prostitutes and their young children, who were close to my age. While society might have judged their mothers, to me, these children were simply my playmates. We were all innocent, looking for fun and camaraderie in the shadow of the Premier Club.

Some memories are stronger than others. On August 10, 1963, the air around us was electric. Dick Tiger, a renowned boxer, had just defeated Gene Fullmer at the Liberty Stadium in Ibadan, Nigeria. The Premier Club must have reverberated with cheers and celebratory music that night.

Owned by an Igbo man named "Ubah," the Premier Club occupied the ground floor of a two-storey building. The place came alive in the evenings, but it was the afternoons, when visiting musicians would rehearse, that I cherished the most. The unmistakable sound of instruments tuning would draw us children like a magnet. We'd sneak inside to witness Zeal Onyia rehearsing hits like "Vicki Nyem Afum," our very own private concert.

Those years in Uromi, growing up amidst the rhythms of life and music, shaped me in ways more profound than one might imagine. The diverse tapestry of experiences, from the resilience of my parents to the innocent escapades at the Premier Club, instilled in me an innate curiosity about the world around me. This curiosity might very well have sown the seeds of my later pursuits in mathematics, physics, and computer science. The harmonies I heard then resonate in the algorithms and equations I'd come to cherish later in life.

DANCING EQUATIONS

Genre: Drama/Biography

Logline: "Dancing Equations" tells the inspiring true story of seven-year-old Philip Emeagwali, who discovers the profound interplay between highlife music and mathematics while standing in a vibrant dancing club in Uromi, Nigeria in 1962. This revelation sparks a lifelong journey where Philip's passion for music and mathematics intertwines, leading him to become a renowned mathematician and computer scientist.

Synopsis:

Act 1:

1. INT. THE PREMIER HOTEL - UROMI, NIGERIA - LATE AFTERNOON - 1962 Young PHILIP EMEAGWALI stands in a corner of the dancing club, witnessing the magical interplay of highlife music and mathematics.
2. INT. DANCING CLUB - NIGHT Philip describes the vibrant atmosphere and the connection between the dancers and the music. He feels an unexplainable fire ignited within him.
3. INT. DANCING CLUB - DANCE FLOOR - NIGHT As the band plays Bobby Benson's "Taxi Driver," Philip taps his feet and sways involuntarily to the infectious rhythm, sensing a profound connection.

   Act 2: 4. INT. DANCING CLUB – NIGHT Philip observes a couple dancing with elegance and confidence, embodying the essence of highlife music. He recognizes the precise steps and movements as a poetic equation on the dance floor.

5. INT. DANCING CLUB - NIGHT The music shifts, and Rex Lawson's trumpet takes center stage. Philip witnesses the intricate movements of the dancers, synchronized to the trumpet's call, and understands the connection between music and mathematics.
6. INT. DANCING CLUB - NIGHT Victor Olaiya's melodies evoke powerful emotions, and Philip sees the parallels between music's ability to evoke feelings and mathematics' ability to unravel mysteries.

Act 3: 7. INT. DANCING CLUB - NIGHT E.T. Mensah's music adds another layer of diversity and culture. Philip realizes the beauty of harmony, both in music's fusion of influences and mathematics' connection to the world.

8. INT. PHILIP'S LAB - YEARS LATER Inspired by the interplay of music and mathematics, Philip embarks on a journey into parallel computing. He draws upon the memories and lessons from the dancing club, pushing the boundaries of computational problems.

9. INT. PHILIP'S LAB - NIGHT Philip faces challenges but is driven by the memories of the dancing club. The power of music, emotions, and interconnectedness fuel his pursuit of understanding.

10. INT. PHILIP'S LAB - DAY The film concludes with a montage of Philip's achievements as a mathematician and computer scientist. The dancing club in Uromi remains a constant reminder of the beauty of music and its profound connection to mathematics.

Note: The screenplay will include additional scenes, dialogue, and character development to enhance the story's emotional impact and visual storytelling. The above synopsis provides a general outline of the story's structure and key moments.

UNLEASHING THE POWER OF PARALLEL PROCESSING

The Journey of a Lone Wolf

In computing, the 1970s and '80s were a time of skepticism and conventional wisdom. The textbooks of that era deemed it impossible to harness the potential of parallel processing or to utilize the collective power of multiple processors. However, my journey as a lone wolf supercomputer programmer defied these limitations. I am Philip Emeagwali, and for over 16 years, beginning on June 20, 1974, I delved into supercomputing, challenging the *status quo* and pushing the boundaries of what was considered possible. On June 20, 1990, marking my sixteenth anniversary in the field, The Wall Street Journal and other esteemed newspapers reported my groundbreaking experimental discovery—how to harness the power of massively parallel processing to create the world's fastest computations. Join me as I recount my journey and the impact of parallel processing on the modern computer and supercomputer.

Breaking the Shackles of Tradition

The prevailing belief in the 1970s was that parallel processing was an exercise in futility, an endeavor that squandered valuable time and resources. Supercomputer textbooks reinforced this skepticism, painting a picture of the impossible. However, armed with determination and an unwavering belief in the untapped potential of parallel processing, I embarked on a mission to challenge the norm. I spent 15 years exploring the intricacies of supercomputing, continuously pushing the boundaries of what was deemed achievable. It became clear to me that my path lay not in textbooks or the teachings of others but in forging ahead on the frontiers of computing, guided by my intuition and relentless pursuit of knowledge.

The Birth of a Revolutionary Idea

On that momentous day, July 4, 1989, my experimental discovery sent shockwaves through the computing world. The Wall Street Journal and other reputable newspapers reported the news—the world had witnessed the dawn of a new era in supercomputing. I had cracked the code, harnessing the power of parallel processing to build supercomputers capable of performing the fastest computations known to humanity. It is worth noting that this monumental achievement did not come from a textbook or a teacher; it was born out of sheer determination and relentless experimentation. My journey mirrored that of an astronaut—just as one does not become an astronaut through theoretical study, one does not become the father of modern supercomputing by merely reading about sequential processing computing. One must venture to the frontiers, pioneering new paths, and embracing the uncharted territories of knowledge.

The Lone Wolf's Quest

In the 1970s and '80s, I stood alone as a full-time supercomputer programmer, daring to challenge the established norms of the industry. While others hesitated, I wholeheartedly embraced the power of parallel processing, even when it seemed like an impossible task. I was the lone wolf, navigating uncharted territories and tapping into the potential of an ensemble of 65,536 commodity-off-the-shelf processors—a feat considered impossible by the textbooks of the time. My relentless pursuit of progress drove me forward, propelling me to create a new internet and master the art of massively parallel processing, forever altering the course of supercomputing history.

Revolutionizing the Modern Supercomputer

Through my pioneering invention, I became the father of the modern supercomputer, forever changing the landscape of computation. By fully

immersing myself in parallel processing, I pushed the boundaries of what was thought to be achievable, paving the way for the modern supercomputers that drive scientific and technological advancements today. As the only full-time programmer of the largest ensemble of commodity-off-the-shelf processors at that time, I transformed the notion of what was possible, leaving an indelible mark on the evolution of computing.

 The story of my journey as a lone wolf supercomputer programmer serves as a testament to the power of tenacity, belief, and the audacity to challenge the status quo. By embracing the potential of parallel processing when others doubted its worth, I carved a path through unexplored terrain and redefined the limits of computation. Today, the impact of parallel processing reverberates throughout supercomputing, enabling us to tackle complex problems and achieve feats once deemed impossible. As we navigate the ever-expanding frontiers of technology, let us remember the spirit of exploration and innovation that drove us to unlock the true power of parallel processing and continue pushing the boundaries of what is yet to be achieved.

Philip Emeagwali

Birth date:

Late afternoon of Monday August 23, 1954

• Birth place:

11 Eke-Emeso Street, Akure, Nigeria.

Where did Philip Emeagwali do his invention?

Ended in Los Alamos, New Mexico, USA

Started at:
195A South Knox Street, Monmouth, Oregon, USA [June 20, 1974]
1800 SW Campus Way, Corvallis, Oregon, USA [June 20, 1974 to June 5, 1977]
Meridian Hill, Washington, DC, USA [1978-1981]
Lived in Room 877 of Meridian Hill Hall at 2601 16th Street that was at the corner of 16th Street and Euclid Street of Adams-Morgan neighborhood of northwest Washington, D.C. Foggy Bottom, Washington, DC, USA [1978-1981]
2101 L Street, N.W. Suite 805 Y Washington, D.C.And so on.

Philip Emeagwali visiting Baltimore, Maryland, from 2601 16th St NW, #877, Washington, DC (c. December 1979).

- What is Philip Emeagwali famous for?:

 Philip Emeagwali invented the world's fastest computing across multiple processors, from June 20, 1974 to July 4, 1989. In 1989, he won the top prize in supercomputing that is referred to as the Nobel Prize of supercomputing.

- An interesting fact
Philip Emeagwali is consistently listed in the top 20 geniuses of all times,

- Philip Emeagwali's Invention:

The world's fastest computer.

- A picture of what they invented.

List three interesting facts about Philip Emeagwali.

519

List three unusual facts about Philip Emeagwali.

THINGS YOU DID'NT KNOW

To be provided.

TIMELINE: EARLY YEARS IN NIGERIA

1857: The first elementary school in Igbo land was sited near the Emeagwali homestead, the present location of General Hospital, Onitsha.

MAY 1921: Nnaemeka, father of Philip Emeagwali, born in Onitsha.

1925: DMGS, the first secondary school in Igbo land was sited near the Emeagwali homestead, 17 Mba Road, Onitsha.

AUGUST 7, 1939: Iyanma, mother of Philip Emeagwali, born in Onitsha.

AUGUST 23, 1954: Chukwurah Philip Emeagwali, born in Akure**.**

DECEMBER 1954: Baptized as "Philip" by William Obelagu at Saint Mary's Catholic Church,

Onitsha.

JANUARY 1956: Arrived in Hausa Quarters, Sapele, Nigeria.

JANUARY 1958: Arrived in Burutu.

JULY 1958: Arrived in Forcados.

JANUARY 1959: Returned to Sapele**.**

JANUARY 1960: Attended St. Patrick's Primary School, Sapele.

OCTOBER 1, 1960: Nigeria becomes an independent nation.

APRIL 1962: Arrived in Uromi. Attended St. Anthony's Primary School.

DECEMBER 1963: Arrived in Agbor. Attended St. John's Primary School.

JANUARY 1966: Enrolled in Saint George's College, Obinomba.

APRIL 1967: Fled as civil uprising refugees from Obinomba to Agbor to Onitsha.

JULY 6, 1967: The Nigerian Civil War began.

OCTOBER 4, 1967: Fled as war refugees from downtown Onitsha that was bombarded for 8 days.

NOVEMBER 1967: Trekked as refugees from Onitsha to Ogidi**.**

DECEMBER 1967: Trekked as war refugees from Ogidi to Awka.

JANUARY 19, 1968: Trekked as war refugees from Awka to Inland Town Onitsha.

MARCH 20, 1968: Trekked for three days (without food) as war refugees from Onitsha to Oba to Awka-Etiti.

JULY 1969: Arrived in Ndoni, Biafra. Conscripted into the Biafran Army and sent to the Oguta War Front.

JANUARY 15, 1970: The Nigerian Civil War ended. Trekked for three days (without food) as war refugees from Ndoni to Onitsha.

MAY 1970: Enrolled for 18 months in Christ the King College, Onitsha.

MARCH 23, 1974: Departed from Nigeria for the USA.

Christopher Okafor, Peter Ozoh, Chude Ukpabi, Philip Emeagwali, two unidentified classmates, at a party in Christ the King College, Onitsha, (~ December 1971).

SHAPING THE FUTURE OF COMPUTING

Philip Emeagwali's Call to Action

 Dear distinguished faculty, honored guests, proud parents, and the remarkable graduates of the **University of Nigeria**, it is with great humility and excitement that I stand before you today. This institution holds a special place in my heart as it is where I could have began my journey in the uncharted territory of science, and now, I have the privilege of addressing the next generation of brilliant minds that will redraw the map of human knowledge.

 Please allow me to introduce myself. I'm Philip Emeagwali. I'm deeply honored to share the extraordinary journey that supercomputing has taken me on. And how it has shaped my life and the world around me.

 It all started with an academic scholarship dated September 10, 1973, which provided me with the opportunity to travel to the United States, arriving on March 24, 1974, at the age of 19. Little did I know that this would mark the beginning of a transformative adventure in computing.

 On June 20, 1974, in Corvallis, Oregon, I began programming one of the world's fastest computers. This moment was a turning point in my life and marked the beginning of my journey in contributing to computing.

 My contributions to computing centered around parallel processing, a groundbreaking approach that harnesses the power of multiple processors to solve complex problems efficiently. Through my mathematical research, I developed efficient algorithms that revolutionized various fields, from weather forecasting and petroleum exploration to medical research and artificial intelligence.

 But beyond the technical accomplishments, I want to emphasize the importance of increasing the body of scientific knowledge. Scientific knowledge is the foundation of progress and innovation. It is through scientific discovery that we have unlocked the secrets of the universe, developed life-changing technologies, and improved the quality of life for millions worldwide.

 Throughout my career, I have learned invaluable life lessons from contributing new discoveries to science. Firstly, embrace curiosity and never stop asking questions. Curiosity fuels the pursuit of knowledge and pushes the boundaries of what we know and understand.

 Secondly, embrace failure as a stepping stone to success. Every setback is an opportunity to learn, grow, and improve. It is through perseverance that we overcome challenges and achieve greatness.

 Thirdly, collaboration is key. Just as parallel processing brings together multiple processors to solve complex problems, collaboration with diverse minds and perspectives enriches our understanding and drives innovation.

As you, the science and technology graduates of the University of Nigeria, embark on your journeys, I urge you to be fearless in your pursuit of scientific knowledge and computing advancements. Embrace the challenges, for they are opportunities to make meaningful contributions to society.

The world is ever-changing, and computing is at the forefront of this transformation. Your passion for computing and scientific discovery can lead to groundbreaking advancements that will shape the future and leave a lasting impact on generations to come.

Congratulations on this momentous achievement, and may your future be filled with boundless possibilities. Go forth with determination, resilience, and a hunger for knowledge. Together, let us continue to increase the body of scientific knowledge and make this world a better place for all.

Thank you!
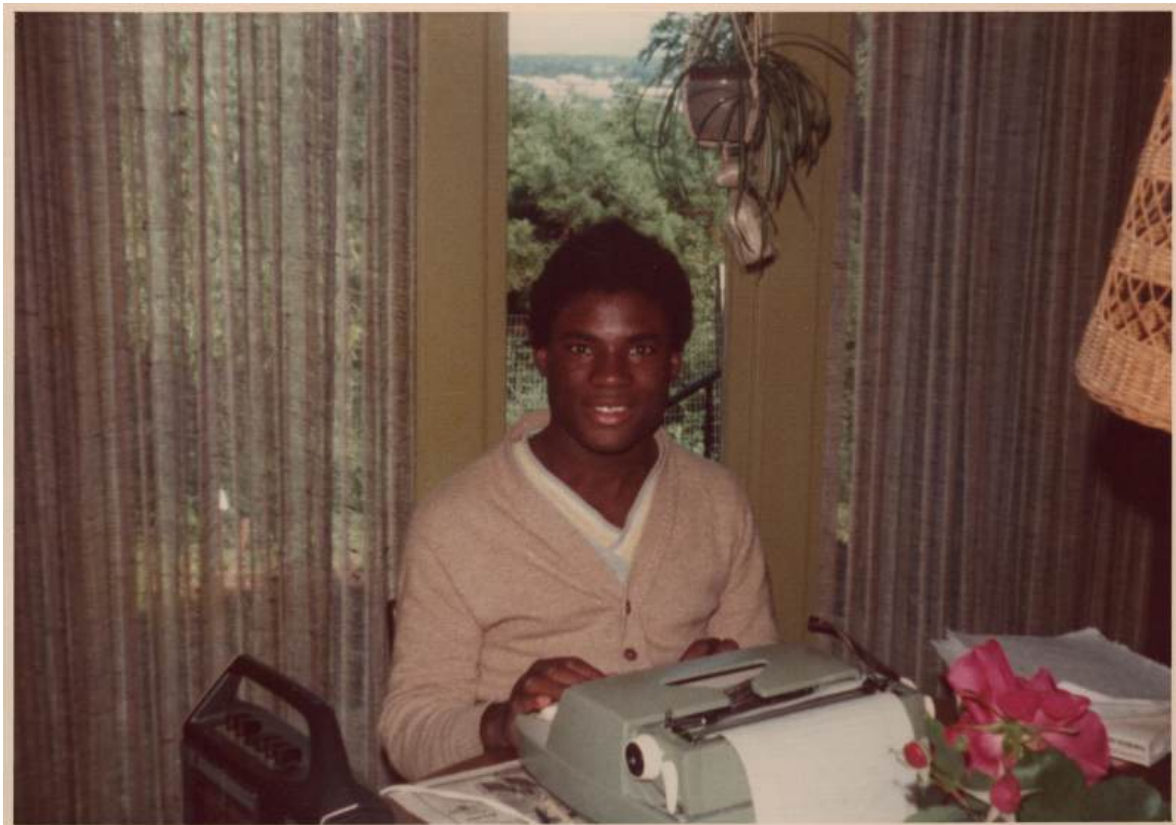
Philip Emeagwali, three years after leaving Christ the King College, Onitsha. Photo taken at 15 Edgewood Way, Corvallis, Oregon, early June 1975.

This is Not Real, It's Just a Dream

 For the 50 years onward of June 20, 1974, in Corvallis, Oregon, I programmed supercomputers and wrote about ten pages a day. A small portion of those writings were shared in my one thousand podcasts and YouTube videos and 20 books.

 Only an expert in three fields—mathematics, physics, and computing—can solve the Grand Challenge problem. I'm known as a computer scientist but my command of materials traversed mathematics and physics. The following images were taken from my yellow pads and blackboards. Roughly, I've covered a distance of 182,500 (or 50 times 365 times 10) pages or blackboards plus programmed supercomputers to solve such Grand Challenge problems. It will be impossible for anybody to understand my 182,500 pages of abstract mathematics, and master them from watching only one YouTube video, instead of in the 50 years it took me. That is, you cannot use a one-hour window of comprehension to become a genius in many fields, including mathematics, physics, computer science, and neighboring sciences. Besides Philip Emeagwali, nobody else had invested 18,250 days that's needed to understand my research to replicate my world's fastest computing and re-deliver my YouTube lectures.

Narrow Window of Comprehension
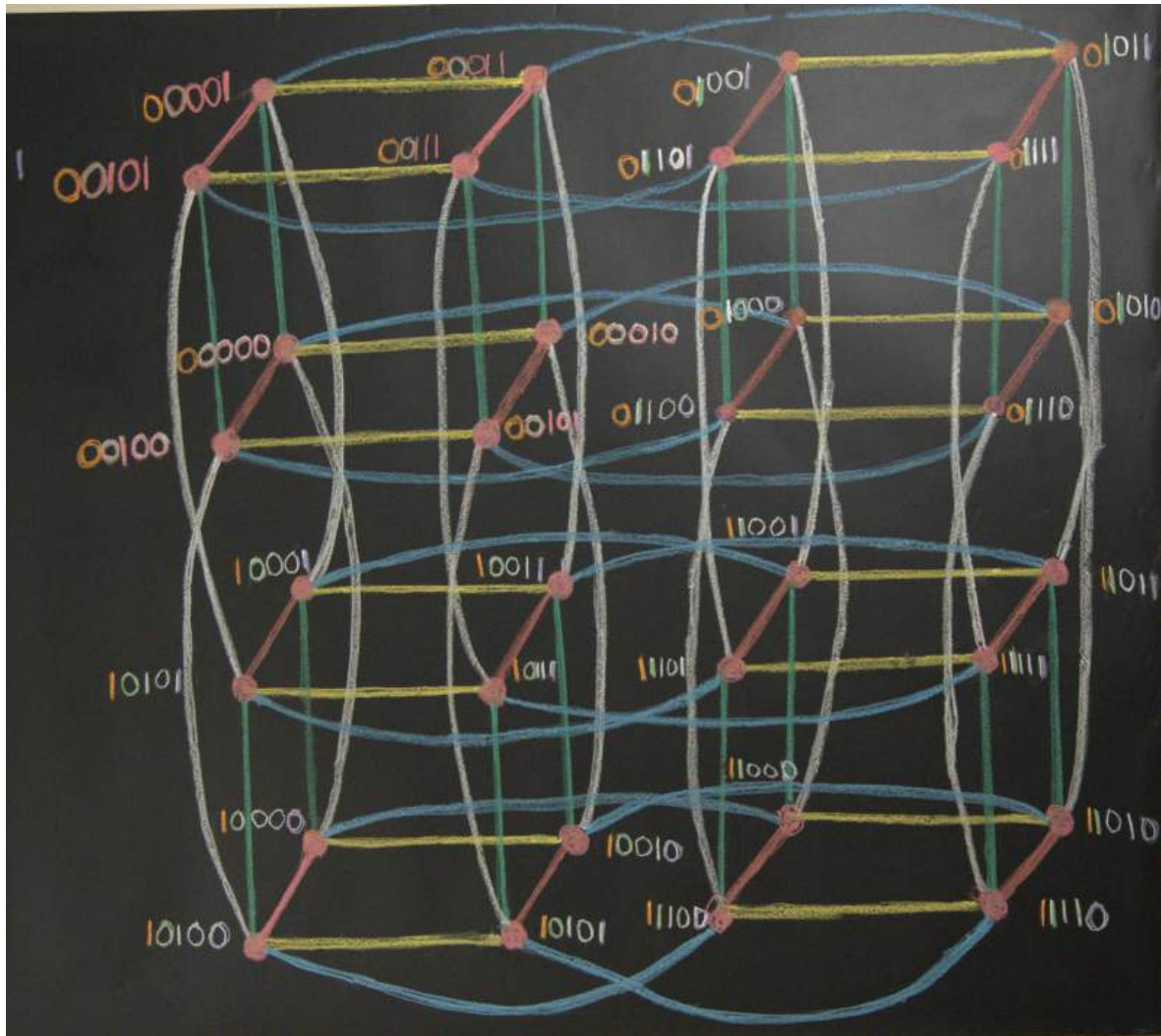
The blackboard from a lecture by Philip Emeagwali on how he executed his world's fastest computing of July 4, 1989, across 65,536 coupled processors that shared nothing.
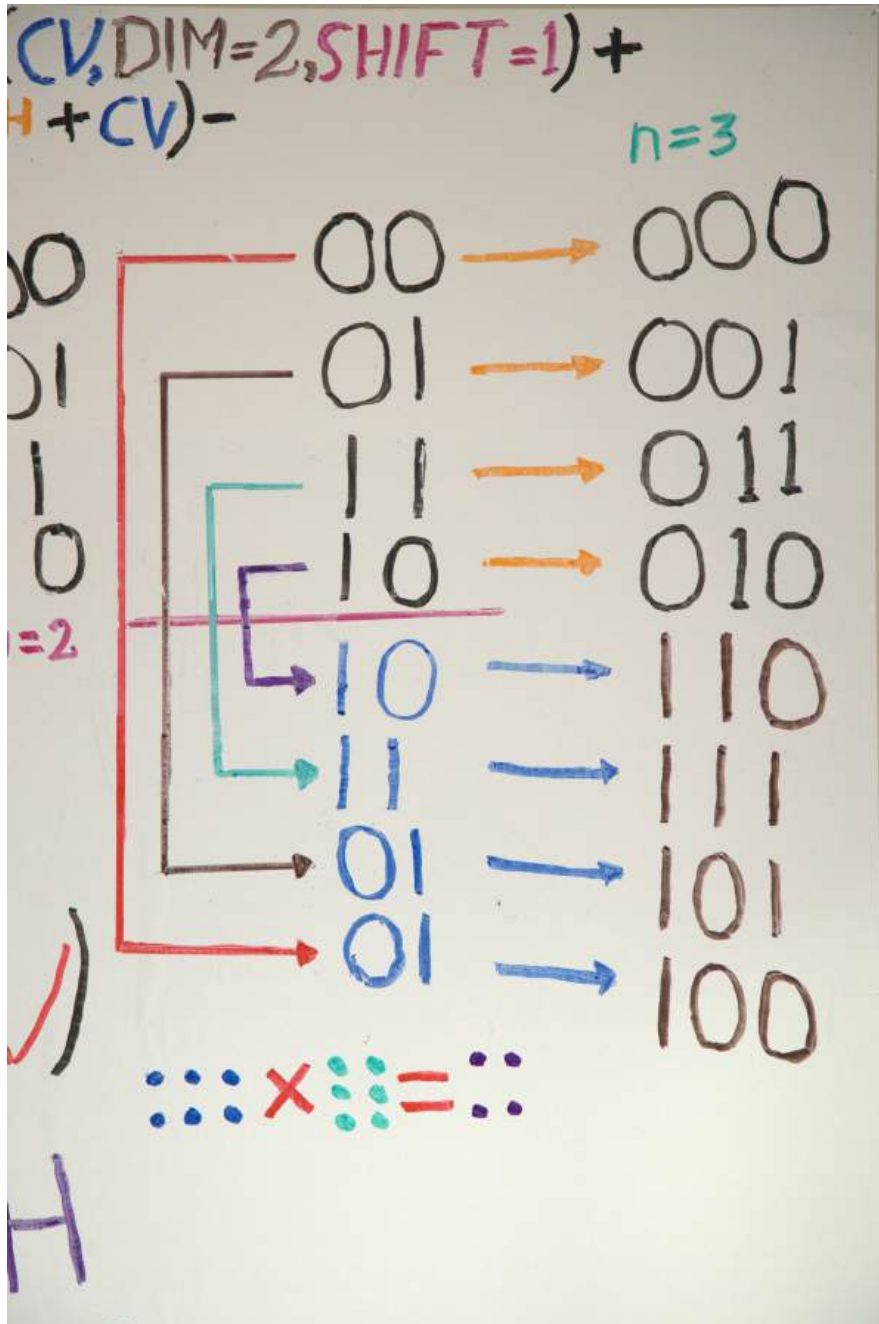
The whiteboard of Philip Emeagwali on how he discovered a one-problem to one-processor mapping that is a necessary condition for his inventing the world's fastest computing of July 4, 1989.
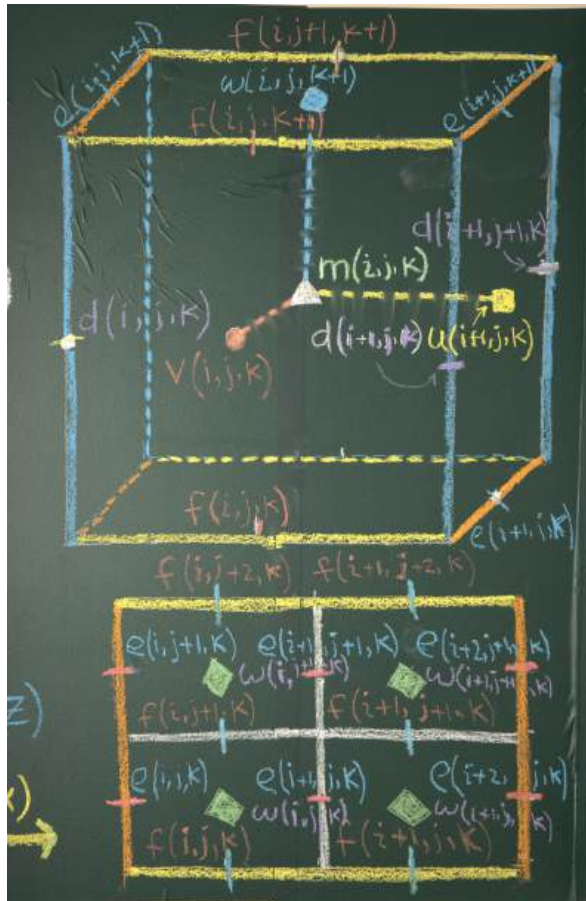
The chalkboard of Philip Emeagwali on the algorithms that he invented for solving his system of coupled, non-linear, three-dimensional, and time-dependent partial differential equations governing fluid dynamical flow computations that was parallel processed for the world's fastest computing across his 65,536 coupled processors.

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial \omega}{\partial P} = 0$$

$$\frac{\partial T}{\partial t} + u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}$$

$$\omega\left(\frac{\partial T}{\partial P} - \frac{RT}{PC_p}\right) = \frac{J}{C_p}$$
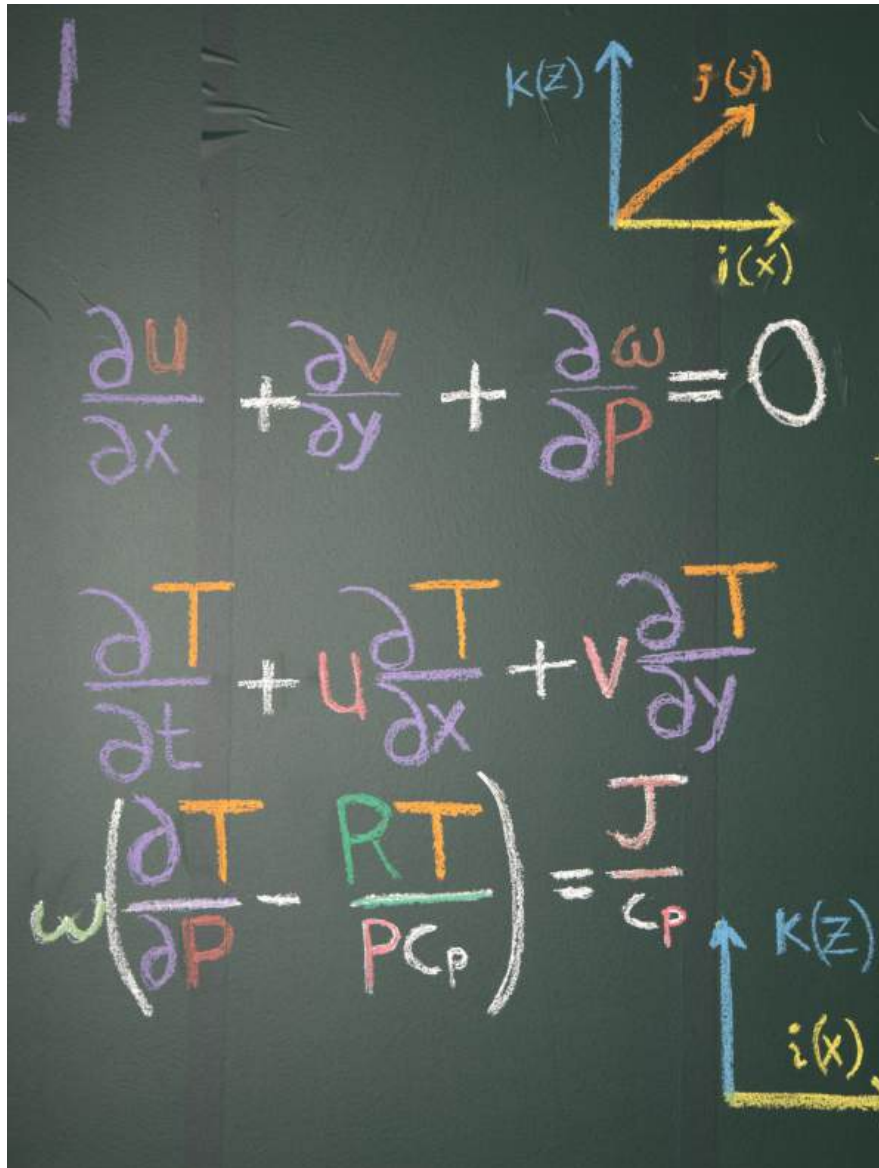
The chalkboard of Philip Emeagwali for partial differential equations of fluid dynamics.

BEYOND QUADRATIC EQUATIONS

To be delivered at Christ the King College, Onitsha, Nigeria.

Ladies and gentlemen, esteemed faculty, proud parents, and most importantly, the incredible graduates of Christ the King College, Onitsha, Nigeria, I stand before you today with a heart full of gratitude and nostalgia. It is an immense honor to return to my beloved alma mater and address the next generation of bright minds.

I'm Philip Emeagwali. I stand here not just as a fellow alumnus but as a mathematician, a scientist, and a dreamer. Today, I will share the incredible journey that mathematics has taken me on, and how it has shaped my life and the world around me.

During the 1970s and 80s, each weekday found me in Kidder Hall in Corvallis, Oregon, where I dedicated countless hours to unraveling the mysteries of mathematics. Or, I was attending rigorous mathematics seminars in College Park, Maryland, seeking knowledge and inspiration from the greatest minds in the field. Alternatively, I could be found searching for new mathematics at the Gramax Building, then the headquarters of the U.S. National Weather Service, Silver Spring, Maryland, or inside the United States Library of Congress, Washington, DC, that's the world's library.

But let me tell you, my friends, it wasn't always an easy path. My journey in mathematics was filled with challenges, doubts, and moments of frustration. Yet, those very challenges served as steppingstones to new discoveries and breakthroughs. And it is those breakthroughs that I will emphasize today, for they embody the essence of why we must strive to increase the body of mathematical knowledge.

Mathematics is not just a subject confined to the quadratic equation, or Pythagoras theorem, on the blackboards of your classrooms. Please allow me to introduce myself. I am the first to discover how to harness millions of coupled processors to solve initial-boundary value problems governed by partial differential equations of calculus. And solve them across the millions of coupled processors that power the world's fastest computers. I am the African supercomputer wizard—living and working in faraway USA—that your grandparents read about, in 1989. I am one of the fathers of the computer that you studied in the first month of your Junior Secondary School One (JSS 1) Computer Studies.

In mid-1970, and six months after the Biafran nation was defeated in the Nigerian Civil War, I sat in Class Two (then called Class Three) and studied algebra with Sylvester Aniga. In Christ the King College, Onitsha, I was only known by the nickname "Calculus." Even my visiting parents knew to ask for "Calculus," not for "Philip Emeagwali."

The partial differential equation of calculus is the very language that governs the universe. It is the mathematical tool we use to understand the natural world, from the smallest particles to the vastness of space. I was in the news headlines because I discovered how the world's fastest computers can be used to solve Grand Challenge problems governed by partial differential equations. Calculus and computers empower us to solve complex problems, create new technologies, and improve the lives of people around the globe. And that is precisely why increasing the body of mathematical knowledge is vital.

My contributions to mathematics came in the form of pioneering parallel computing, a revolutionary mathematical approach to harnessing the power of a million coupled processors to solve complex problems, called Grand Challenges. My contributions to mathematics enabled the U.S. to simulate weather patterns around the Earth, Nigeria to discover new oil fields up to eight miles deep, and astronomers to explore the depths of the universe and see the farthest stars that are 28 billion light-years away, among other accomplishments. But beyond my world's fastest computing that made the news headlines—shortly after I discovered it on July 4, 1989—I learned some valuable life lessons along the way.

Firstly, never fear the unknown, for it is in uncharted territory that innovation thrives. Embrace the challenges, for they are opportunities to learn and grow. Secondly, collaboration is key. Just as we need a million processors to solve complex problems, we need a billion diverse perspectives and a trillion ideas to tackle the challenges of our time. Work together, support one another, and you will achieve greatness.

Lastly, believe in yourself and your dreams, even when others doubt you. When I began my journey in mathematics, some said it was impossible for a Black African—born and raised in Nigeria—to make significant contributions. But I persisted, and my passion for mathematics drove me forward. Let your passion be your compass, and you will find your way to success.

As you, the graduates, step into the world beyond these walls, I implore you to be fearless in your pursuit of knowledge. Mathematics is a gateway to endless possibilities. And you hold the power to shape the future through your contributions to this ever-expanding field.

So, my dear graduates, go forth with determination, with resilience, and with a hunger for knowledge. Remember that your time here at Christ the King College has prepared you for the challenges ahead and to embrace the beauty of mathematics and all the wonders it can unlock.

Congratulations, Class of 2025, and may your journeys be as transformative as mine has been. Together, let us continue to explore the frontiers of mathematics and make this world a better place for generations to come. Thank you!

Philip Emeagwali, 15-months after leaving Christ the King College. Photo taken at 5 Oguta Road, Onitsha, June 1973.

Notes: Flickr has photos of Philip Emeagwali in Christ the King College, Onitsha, 1971

LEAVING AN INDELIBLE MARK ON MATHEMATICS

Unraveling the Mystery of Parallel Processing

Beginning from May 1981, at the intersection of computational physics, parallel processing, and mathematics, I embarked on a groundbreaking journey to harness the power of parallel supercomputing for solving complex problems in fluid dynamics. The poster boy and girl of large-scale computational fluid dynamics calculations are weather forecasting and petroleum reservoir simulation, respectively.

In 1981 and in College Park and Silver Spring, Maryland, I delved into the stability and convergence analyses, both theoretically and experimentally, of the finite difference discretization of the shallow water equations that govern oceanic flows. Those investigations provided the mathematical foundation for my discovery, on July 4, 1989, of the first world's fastest computing across 65,536 coupled processors. That discovery became my signature contribution to mathematics. For my explicit finite difference discretizations that were candidates for massively parallel processing, I sought to establish the consistency, stability, and convergence properties of each method, but my path to success was paved with challenges and uncertainties.

Finite Difference Discretization of the Shallow Water Equations

Before I delved into parallel processing, I needed a robust numerical method to simulate the behavior of fluids. The shallow water equations provided a suitable model for my endeavors, such as solving initial-boundary value Grand Challenge problems that are governed by the primitive equations of meteorology. These partial differential equations describe the motion of shallow water waves, making them ideal for understanding various hydrodynamic phenomena, such as determining the global atmospheric flow patterns.

To convert these continuous—primitive and shallow water—equations into their discrete, or algebraic, approximations that can be solved in finite time on a supercomputer that's powered by millions of coupled processors, I employed the finite difference method. I did so by approximating the derivatives in the—primitive and shallow water—equations with discrete differences, which enabled me to express the fluid dynamics problem as a very large system of algebraic equations.

Struggles to Prove Stability and Convergence

My finite difference discretizations of the primitive and shallow water equations were pre-conditions for my developing the message-passing codes for my supercomputer simulations, but it was crucial to ascertain their stability and convergence properties. Stability ensured that my numerical solution to my initial-boundary value Grand Challenge problems remained bounded over time, while convergence confirmed that the solution approached the true solution as my finite difference discretization parameters were refined.

Proving stability and convergence for any finite difference approximation was no easy feat. Stability can only be proven for simplifications of the discretized primitive and shallow water equations. I was well aware of the equivalence theorem of 1954, a powerful result in numerical analysis that stated that a consistent and stable numerical method would converge to the exact solution under certain conditions. However, the challenge lay in actually demonstrating these properties for the specific finite difference scheme I employed for the shallow water equations.

The Equivalence Theorem

The equivalence theorem was my guiding light throughout my journey to the frontier of finite difference discretizations of the primitive and shallow water equations. The equivalence theorem assured me that if my finite difference scheme was consistent—or faithfully representing the original partial differential equations—and stable (that is, the numerical solution did not amplify errors over time), then it would converge to the true solution of the primitive or shallow water equations. However, proving these properties for my particular scheme demanded extensive theoretical analysis and rigorous experimentation.

Theoretical Analysis

Each day of the first half of the 1980s and in College Park, Maryland, I engaged in countless hours of theoretical analysis, diving deep into the intricacies of the finite difference scheme. I scrutinized stability conditions, examined von Neumann stability analysis, and explored the inherent challenges posed by the nonlinearity of the shallow water equations. This analytical groundwork was essential for building a solid foundation for my subsequent experiments.

Experimental Validation

  Theoretical analysis alone was insufficient to ascertain the stability and convergence properties of the finite difference scheme. I embarked on extensive experimentation, implementing the numerical methods that I invented across an ensemble of up to 65,536 processors that were coupled and identical to each other. On July 4, 1989, and in Los Alamos, New Mexico, USA, my massively parallel processing paradigm enabled me to divide the computational load across 65,536 processors, significantly speeding up my solutions of initial-boundary value problems governed by partial differential equations and doing so by a factor of 65,536 to record my world's fastest computing that made the news headlines.

  The process of experimentation was iterative and arduous, as I had to fine-tune various parameters and verify the accuracy and stability of the results. Each experiment taught me valuable lessons, leading to further refinements and insights into the stability of the finite difference approximation.

Contributions of Philip Emeagwali to Mathematics

  Through sheer determination and relentless perseverance, I established the linearized stability and convergence properties of the finite difference discretizations of the primitive equations of meteorology and the shallow water equations of oceanography. This breakthrough was pivotal in my selection of finite difference discretizations of an initial-boundary value problem governed by the Philip Emeagwali equations that were at the mathematical foundation of my 1989 discovery of the first supercomputing, as we know it today, namely, across millions of coupled processors. My contribution to science is this: I forged a link between computational physics, parallel processing, and mathematics, showcasing the interdependence of these disciplines in unlocking the mysteries of planetary-scaled fluid dynamics. My mathematical research laid the groundwork for future researchers to employ parallel computing techniques for a wide range of scientific and engineering applications, transcending the limitations of sequential and vector supercomputing.

Conclusion

  The analyses of the finite difference discretizations of initial-boundary value problems governed by partial differential equations—such as the

primitive and shallow water equations—were monumental achievements that laid the foundation for my groundbreaking discovery of parallel processing's capabilities in computational physics. The struggles, challenges, and dedication to prove the stability and convergence properties served as a testament to the importance of theoretical analysis and experimental validation in computational science. My journey to the frontier of knowledge that was the intersection of computational physics, parallel processing, and mathematics has left an indelible mark on the field, opening new horizons for scientific exploration and problem-solving at the world's fastest computing speeds and across millions of coupled processors that compute and communicate in tandem and with a one-processor to one-problem correspondence.

Thank you.

11 31   231107-1

MARCH 24, 1974: Arrived in Oregon, USA.

JUNE 20, 1974: Began programming the first computer to be rated at one million instructions per second.

JUNE 5, 1977: Moved from Corvallis, Oregon, to Washington, DC.

OCTOBER 1977: Moved from Washington, DC, to Baltimore, MD.

OCTOBER 1978: Moved back to Washington, DC.

AUGUST 1981: Married Dale Brown in Baltimore, Maryland.

APRIL 1986: Moved from Washington, DC, to Wyoming.

AUGUST 1987: Moved from Wyoming to Michigan.

JULY 4, 1989: Discovered the first supercomputing across multiple processors.

TIMELINE OF PHILIP EMEAGWALI COMPUTER

Contributions to the Computer

 469 BC—Abacus Invention: The Abacus, known as the oldest computing aid, is invented in China, offering a simple method for performing calculations.

 200 BC—Water Clock Invention: In the Nile Valley of Africa, the water clock is invented. This technology serves as an inspiration for the development of early computers due to its capability of counting and measuring time.

 70 AD—Origin of the Term 'Computer': Pliny the Elder uses a Latin term that is later translated or referred to as "computer".

 100 AD—Sequence Control by Heron: The mathematician Heron describes the first known sequence control, laying the foundation for computer programming by enabling the prediction of output based on a given input.

 476 AD—Introduction of Zero: The Indian mathematician Aryabhata introduces the number zero, a fundamental element of the binary system used by computers, which recognizes only the numbers 0 and 1.

 800 AD—Al-Khwarizmi's Publication: The Persian mathematician Muhammed ibn Musa Al-Khwarizmi publishes Al-jabr wa'l muqabalah, with the terms "Al-Khwarizmi" and "Al-jabr wa'l" evolving into "algorithm" and "algebra," respectively.

 1398—Another Origin of the Term 'Computer': The term "compotystes" is coined to describe individuals who perform calculations. Over time, this term evolves into the modern word "computer."

 1621—Slide Rule Invention: The slide rule is invented as a computing aid that facilitates quick multiplication and division calculations.

1922—**Sci-Fi Prediction:** A piece of science fiction published on February 1, 1922, envisions the use of 64,000 human computers for weather forecasting above the Earth's surface.

1946—**Programmable Computer Invention:** The programmable computer is invented, marking a significant milestone in computing technology.

1974—**Emeagwali's Supercomputing Theory:** Philip Emeagwali formulates a theory suggesting that 64 thousand computers around the Earth could be replaced with 64 binary thousand processors uniformly distributed across a spherical surface. This concept becomes known as the "Philip Emeagwali Internet."

1989—**Emeagwali's Supercomputing Discovery:** On July 4, 1989, Philip Emeagwali achieves a groundbreaking world's fastest computing by successfully using 65,536, or two-raised-to-power-16, processors that are coupled yet sharing nothing—that he visualized as uniformly distributed across a spherical surface in 16-dimensional hyperspace—for computations to hindcast weather conditions deep inside the Earth.

1989—**Parallel Processing Breakthrough:** Also in 1989, Emeagwali invents a method for supercomputing via parallel processing, making a significant contribution to the advancement of computational science.

This timeline provides a broad overview of the progression of the world's fastest computing—the benchmark, metric, and milestone—for celebrating contributions to the speed of the computer. The timeline leads up to and including Emeagwali's world's fastest computing of July 4, 1989.

NAVIGATING BOUNDARIES

A Mathematician's Odyssey from Ancient Foundations to Modern Breakthroughs

 Ladies and gentlemen, esteemed mathematicians, physicists, supercomputer scientists, distinguished scholars, dignitaries from the United States and Africa, young scholars across continents watching this live, and fellow pursuers of knowledge,

 I stand before you not merely as Philip Emeagwali, but as a testament to the relentless spirit of human curiosity that transcends borders and epochs. My journey that began in Nigeria and wove its course through the United States is one of perseverance, challenges, and discoveries. Today, we shall traverse this voyage of exploration not merely through the lens of my narrative but through the expansive vistas of mathematics, physics, computer science, and their neighboring disciplines.

 Let us journey back to 1665, when calculus was birthed into our world by the brilliant minds of Gottfried Leibniz and Isaac Newton. This was an era when science was taking its baby steps, evolving slowly but steadily. By 1770, the term "partial differential equation" began to appear in literature. These equations became the hidden heroes, the backbone of much of our technological advancements today.

 But my story truly begins in the 1970s and 80s, in Corvallis, Oregon, and College Park, Maryland, where I began my quest to push the boundaries of human knowledge. I pursued questions that were not just theoretical conundrums but had direct implications on our modern society. The oil and gas industry, for instance, sought to optimize the extraction of petroleum, a task that required simulating reservoirs using nine partial differential equations that I eventually formulated. This discovery extended the boundaries of computational physics and redefined how we harness the potential of massively parallel processing supercomputers.

 It was here that I confronted the Grand Challenge problem, the enigma that had befuddled scientists for decades. Solving this required a blend of theoretical, experimental, and computational methodologies. But more than the technical prowess, it was a testament to the indomitable spirit of inquiry.

 Fluid dynamics, a field initiated by the Euler equations in 1757, saw a pivotal shift with the introduction of the Navier-Stokes equations. These equations, that now bear the names of the French engineer Claude-Louis *Navier* and the Irish politician and theologian George Gabriel Stokes, find their applications in diverse fields, from NASA's computations for the B-747 airplane transporting the Space Shuttle Orbiter to predicting patterns inside a centrifugal compressor.

These equations are described in vectorial form. But to truly grasp their intricacies, one must understand the conservation of momentum laws along the x-, y-, and z- directions. Coupled with the conservation of mass and energy equations, this forms a system replete with a myriad of partial derivative terms. Solving the Navier-Stokes equations is a complex task, necessitating the specification of initial and boundary conditions. In viscous flows, one must incorporate the divergence of the viscous stress tensor and the viscous terms. The importance of these equations cannot be overstated.

The Prandtl number, the Reynolds number, the energy equation—these terms may sound esoteric to the uninitiated. Yet, they underpin the fabric of our understanding of fluid dynamics. For instance, the Reynolds number gives us insight into the behavior of fluid flow, helping decipher the intricate dance between viscous and inertial forces.

The world witnessed a significant leap in 1989, when I unveiled the potential of parallel processing, showcasing the fastest computations using 65,536 processors. This wasn't merely a technological feat, but a paradigm shift, redefining our understanding of initial-boundary value problems that lay at the intersection of mathematics, physics, and parallel computing.

To the young 15-year-old in Africa: Remember, every significant leap in human knowledge has come from persistent curiosity and relentless perseverance. Embrace challenges, for they are the crucibles in which great ideas are forged.

To the 12-year-old in the USA writing about "Black Inventors": Draw inspiration from stories like mine, but remember, your unique narrative and contributions to the world await. Your potential is boundless.

So, how did I change the world? By showcasing the potential of parallel processing, by advancing our understanding of computational physics, but most importantly, by embodying the spirit of perseverance and unquenchable curiosity.

My journey underscores the imperative that countries like Nigeria and the entire African continent must not just be consumers but pioneers at the frontiers of human knowledge. Let Africa rise, not just as a continent of vast natural resources but as a beacon of intellectual contribution, driving the next renaissance in science, technology, and innovation.

Thank you

TBA Image: Philip Emeagwali on the blackboard explaining the Navier-Stokes equations.

7 46

231106-3

1. How did Philip Emeagwali's research challenge the prevailing beliefs in the field of supercomputing?
2. Why was Philip Emeagwali's discovery of parallel supercomputing met with skepticism and ridicule?
3. How did Philip Emeagwali's discovery of parallel supercomputing impact the times-to-solution of compute-intensive problems?
4. Why were six copies of Philip Emeagwali's research report thrown into the wastebasket initially?
5. What was the significance of Philip Emeagwali winning the equivalent of the Nobel Prize in supercomputing?
6. What challenges did Philip Emeagwali face as a Black mathematician in gaining recognition for his work?
7. How did Philip Emeagwali's background in mathematics, physics, and computer science contribute to his ability to solve complex supercomputing problems?
8. What factors contributed to Philip Emeagwali being underestimated and undervalued in the field of supercomputing?
9. How did Philip Emeagwali's invention of parallel supercomputing change the landscape of high-performance computing?
10. What role did Philip Emeagwali's discovery play in advancing fields such as computational fluid dynamics and computational medicine?
11. How did Philip Emeagwali's discovery challenge the limitations imposed by Darcy's Law and Amdahl's Law?
12. What were the criticisms and objections raised by the vector supercomputing community against Philip Emeagwali's theory?
13. How did Philip Emeagwali's research on parallel supercomputing pave the way for the development of massively parallel supercomputers?
14. What were the limitations of the supercomputers of the 1980s, and how did Philip Emeagwali's discovery change that?
15. How did Philip Emeagwali's discovery of parallel supercomputing impact the simulation of global pandemics like Covid-19?
16. What inspired Philip Emeagwali to investigate the rates of error growth in solving large-scale systems of equations?

17. How did Philip Emeagwali's stability analyses contribute to the development of efficient algorithms for solving computational fluid dynamics problems?
18. What challenges did Philip Emeagwali face in mapping his codes across a large number of processors?
19. How did Philip Emeagwali's reformulation of tridiagonal systems into diagonal systems enable parallel processing of compute-intensive problems?
20. How did Philip Emeagwali's discovery challenge the conventional wisdom of solving one problem at a time on the fastest processor?
21. What were the implications of Philip Emeagwali's discovery for the field of computational mathematics?
22. How did Philip Emeagwali's interdisciplinary approach as a polymath contribute to his invention of new partial differential equations?
23. What was the significance of Philip Emeagwali's discovery of nine new partial differential equations derived from the Second Law of Motion?
24. How did Philip Emeagwali's new governing system of hyperbolic partial differential equations revolutionize the field of calculus?
25. How did Philip Emeagwali's discoveries in supercomputing contribute to solving real-world problems, such as simulating the motions of fluids in oil reservoirs?

1. What is the significance of discretizing partial differential equations in computational linear algebra?
2. How did Philip Emeagwali contribute to solving large systems of equations in petroleum reservoir simulation?
3. What is the alternating direction implicit (ADI) method, and how was it used in solving subsurface geophysical fluid dynamics problems?
4. Why did Philip Emeagwali find it impossible to solve a system of tridiagonal equations in parallel?
5. How did Philip Emeagwali transform tridiagonal systems into diagonal systems for faster solutions?
6. What impact did Philip Emeagwali's mathematical inventions have on solving compute-intensive problems in computational physics?
7. How did Philip Emeagwali utilize a new global network of processors to solve initial-boundary value problems in petroleum reservoir simulation?
8. What challenges did Philip Emeagwali face as a Black scientist in the 1970s and 80s, and how did he overcome them?
9. How did Philip Emeagwali's discovery overcome Amdahl's Law and push the limits of parallel supercomputing?
10. What is the significance of Philip Emeagwali's mapping and correspondence between processors and problems in parallel computing?
11. How did Philip Emeagwali's invention of a new Internet contribute to solving the world's most challenging problems?
12. What is the importance of Amdahl's Law in computer science, and how did Philip Emeagwali challenge its limitations?
13. How did Philip Emeagwali's breakthrough algorithm revolutionize the field of algebra and computational linear algebra?
14. Why was parallel processing not initially favored for solving initial-boundary value problems in extreme-scale algebra and computational physics?
15. How did Philip Emeagwali harness slow processors to achieve the fastest computing speeds in the world?

16. What challenges did Philip Emeagwali face from computational mathematicians who dismissed parallel supercomputing in the 1980s?
17. How did Philip Emeagwali program and instruct each processor to solve a system of equations in parallel?
18. What was the significance of solving a system of 24 million equations across 65,536 processors?
19. How did Philip Emeagwali's algorithms and codes contribute to solving computational linear algebra problems?
20. How did Philip Emeagwali's discoveries impact the field of high-performance computing and the development of supercomputers?
21. What is the role of parallel processing in solving the most compute-intensive problems in the world?
22. How did Philip Emeagwali's contributions change the way mathematicians and scientists approach challenging problems in physics, mathematics, and computer science?
23. How did Philip Emeagwali's persistence, dedication, and hard work contribute to his success in supercomputing?
24. What lessons can be learned from Philip Emeagwali's journey as a researcher and inventor in the field of supercomputing?
25. What is the future potential of quantum computing in advancing supercomputing beyond the limitations of parallel processing?

1. How did the author visualize the world's fastest computing across a new internet?
2. What were the long-lasting cultural, social, and economic impacts of global pandemics that the supercomputer was used to model?
3. How did the author use metaphorical language to describe the computing vertices and circumscribing sphere?
4. What were the dimensions the author visualized the cube and sphere in, and what significance did they hold?
5. How did Philip Emeagwali envision the Philip Emeagwali Internet as a global network of computers?
6. What were the challenges faced by the author as a Black mathematician in the USA?
7. How did the author email computational fluid dynamics codes to millions of processors?
8. What unique identifier did each processor have, and how were they connected?
9. What instructions did the author invent for each processor, and what problems did they solve?
10. How did the author's mathematical quest for the world's fastest computing begin and end?
11. Who were some of the mathematicians the author recognized in the calculus book, and what contributions did they make?
12. How did the author's early years in Nigeria shape his journey as a supercomputer scientist in the USA?
13. Why did the author conduct his research alone as a large-scale computational mathematician?
14. What limitations did the author face in using desktop computers for supercomputing compared to his use of sixteen supercomputers?
15. How did the author's discovery of the world's fastest computing challenge the beliefs of supercomputer scientists?
16. What was the significance of the number of vector supercomputer scientists in the world during the 1980s?

17. How did the author's struggles and dismissals from scientific research teams reflect the lack of understanding of parallel processing?
18. How did the author's discovery of parallel supercomputing change the way we look at the fastest computers?
19. What is the significance of massively parallel processing in solving compute-intensive problems?
20. How did the author's discovery of fastest computing change the computer industry and enrich science, engineering, and medicine?
21. How did the author's invention of fastest computing challenge the traditional notions of supercomputing?
22. What are the possibilities of changing the way we look at the Internet through parallel supercomputing?
23. How did the author's discovery of fastest computing revolutionize the performance of the world's fastest computers?
24. How did the author's objective and quantifiable metrics support his scientific discovery of parallel supercomputing?
25. How does the author want to be remembered and what is the significance of scientific discoveries and inventions?

1. How did the discovery of the world's fastest computing using the slowest processors impact the field of mathematics?
2. What role did the invention of the supercomputer technology play in solving complex problems in computational fluid dynamics?
3. How did the discovery of parallel supercomputing change the way mathematicians approach unsolved systems of equations?
4. Why was the African supercomputer genius's invention of solving large systems of equations in algebra significant?
5. How did the use of an ensemble of millions of processors revolutionize the speed of calculations in the petroleum industry?
6. What is the relationship between supercomputing and forecasting weather in petroleum reservoir simulation?
7. Why is the supercomputer technology important for oil-producing nations like Nigeria?
8. How did the discovery of the world's fastest computing impact the field of modern algebra?
9. What was the significance of solving the largest system of equations using parallel supercomputing across a global network of processors?
10. How did Philip Emeagwali's mathematical quest contribute to solving previously unsolved problems in computational fluid dynamics?
11. What challenges did Emeagwali overcome to invent the fastest computing using slow processors?
12. How did the invention of the supercomputer technology impact the petroleum industry's ability to locate crude oil and natural gas deposits?
13. What were the limitations and criticisms of parallel processing before Emeagwali's discovery?
14. How did Emeagwali's discovery challenge the established belief that slow processors cannot compute together?
15. What role did the mathematical metaphors between meteorology and geology play in Emeagwali's computational mathematics?

16. How did Emeagwali reformulate the hardest problem in subsurface geology and apply it in a meteorological context?
17. What was the significance of the diagonal and tridiagonal systems of equations in Emeagwali's mathematical discoveries?
18. How did Emeagwali's new system of equations in computational linear algebra contribute to solving extreme-scale computational physics problems?
19. How did Emeagwali visualize and solve the Grand Challenge problem of supercomputing using his ensemble of processors?
20. What is the difference between the diagonal and tridiagonal systems of equations in terms of their mathematical and physical essences?
21. How did Emeagwali's invention of parallel processing across slow processors overcome skepticism and contribute to supercomputing advancements?
22. What was the significance of Emeagwali's supercomputing breakthrough in reducing time-to-solution for compute-intensive problems?
23. How did Emeagwali's discovery reshape the way mathematicians approach and solve their most compute-intensive problems?
24. What impact did Emeagwali's discovery have on the oil and gas industry's ability to harness the power of supercomputing?
25. How did Emeagwali's invention of fastest computing using slow processors change the way computers are viewed and utilized in various fields?

1. Who is Philip Emeagwali and what is he known for?
2. What inspired Philip Emeagwali to pursue a career in computer science?
3. Can you explain what "massively parallel processing" means and how Philip Emeagwali contributed to its development?
4. How did Philip Emeagwali's experiences as an immigrant shape his scientific work?
5. What are some of the practical applications of Philip Emeagwali's work in computer science?
6. How did Philip Emeagwali use his knowledge of fluid dynamics to make advancements in fields like weather prediction and environmental engineering?
7. Can you think of any challenges Philip Emeagwali may have faced in his career, and how did he overcome them?
8. Why is it important for scientists like Philip Emeagwali to communicate complex ideas to the general public?
9. How do you think Philip Emeagwali's work has impacted the lives of people around the world?
10. What can we learn from Philip Emeagwali's determination and innovative thinking? How can we apply those lessons in our own lives?

PHILIP EMEAGWALI: FAQS

What are the hobbies of Philip Emeagwali?

When I'm not busy exploring computers, I love to be active and enjoy the outdoors. One of my favorite hobbies is playing tennis. It's a great way to exercise, have fun, and challenge myself. I also enjoy weightlifting to stay strong and healthy.

But my absolute favorite outdoor activities are cross-country skiing in the winter and hiking in the warmer months. There are so many beautiful places to explore in upstate New York, like Lake George and Lake Placid. The fresh air, the stunning scenery, and the physical challenge of these activities help me clear my mind and recharge my batteries.

It might seem surprising that a computer scientist would be so passionate about outdoor sports, but for me, it's all about balance. Just like a computer needs both hardware and software to function, I need both mental and physical stimulation to thrive. So, whether I'm writing code or hitting the slopes, I'm always looking for new ways to learn, grow, and have fun.

What is the favorite color of Philip Emeagwali?

That's an interesting question! You know, I find beauty in all colors, just like I find fascination in all the possibilities of technology. But if I had to choose one color that inspires me the most, it would be **green**.

Green reminds me of nature, growth, and the interconnectedness of all things. It represents the energy of life and the potential for new beginnings. Just like a tiny seed grows into a mighty tree, my ideas have grown into innovations that help people worldwide.

So, you could say green is the color of creativity and hope for me. It's a reminder that even the smallest ideas can blossom into something amazing if we nurture them with passion and dedication.

What are the character traits of Philip Emeagwali?

Hello! As Philip Emeagwali, I'm delighted to help you answer this question.

When I think about the character traits that describe me, I would say that perseverance is a crucial one. Growing up, I faced many challenges, including poverty and limited access to education. But I never gave up on my dreams. I worked hard, persevered, and believed in myself, despite the obstacles.

Another important character trait for me is creativity. As a mathematician, I've always tried to find innovative solutions to complex problems. I draw inspiration from nature, art, and even music to approach problems from unique angles. This creativity has allowed me to develop new algorithms and techniques that have made a significant impact in high-performance computing.

I would also say that I'm a curious and lifelong learner. I've always been fascinated by the world around me and have a desire to understand how things work. This curiosity has driven me to continue learning, exploring new ideas, and pushing the boundaries of what's possible.

Finally, I believe that passion and determination are essential character traits for anyone who wants to make a difference. I've always been passionate about math and science, and I've dedicated myself to making a positive impact in these fields.

So, to answer your question, the character traits that define me are perseverance, creativity, curiosity, and passion. I hope these traits inspire you, the 12-year-olds writing your school reports, to chase your dreams and pursue your passions with determination and perseverance!

EMEAGWALI COMPUTER

Unveiling the Bee's Blueprint

Ladies and gentlemen, esteemed scientists, and distinguished guests,

It is with great honor and humility that I stand before you today, in these hallowed halls, to share the story of a journey that intertwines mathematics, physics, and computing in a symphony of innovation and inspiration.

For half a century, I embarked on a quest, like a troubadour, seeking the melodies hidden within the depths of the universe. In equations, I composed symphonies, and in the spirit of Bob Marley, I poured my soul into the creation of a harmonious masterpiece. My path was not one of traditional academia, but rather an exploration that drew inspiration from the world.

As I delved deeper into the wonders of nature, I marveled at the extraordinary efficiency of the bee—the tireless architect of the honeycomb. Over millions of years, the bee evolved to understand that the storage of honey requires the least energy when arranged in a hexagonal pattern. It was this revelation that became the cornerstone of my journey—an epiphany that inspired my invention of the first world's fastest computing across many processors.

554

I took it upon myself to reverse engineer the bees' honeycomb, copying its blueprint with meticulous precision. It was through this process that the Philip Emeagwali supercomputer was born—a testament to the extraordinary intelligence encoded within the natural world. The interconnections of processors within this supercomputer were inspired by the intricate patterns observed in the honeycomb—the very architecture that will enable us to manufacture the world's fastest computers.

In this age of rapid technological advancement, artificial intelligence has emerged as a driving force, shaping the future of our world. And at the heart of this transformation lies the parallel supercomputer—an invention that I am honored to claim as mine. It is through the power of parallel processing that we unlock the immense potential of artificial intelligence—a force that has the capacity to reshape industries, solve complex problems, and elevate human potential to unprecedented heights.

But beyond the technical achievements lies a deeper message—an inspirational lesson that transcends the boundaries of science and technology. It is the realization that innovation is not limited to the confines of traditional academia or conventional pathways. It is a reminder that brilliance can emerge from the most unexpected sources—that a spark of genius resides within each and every one of us.
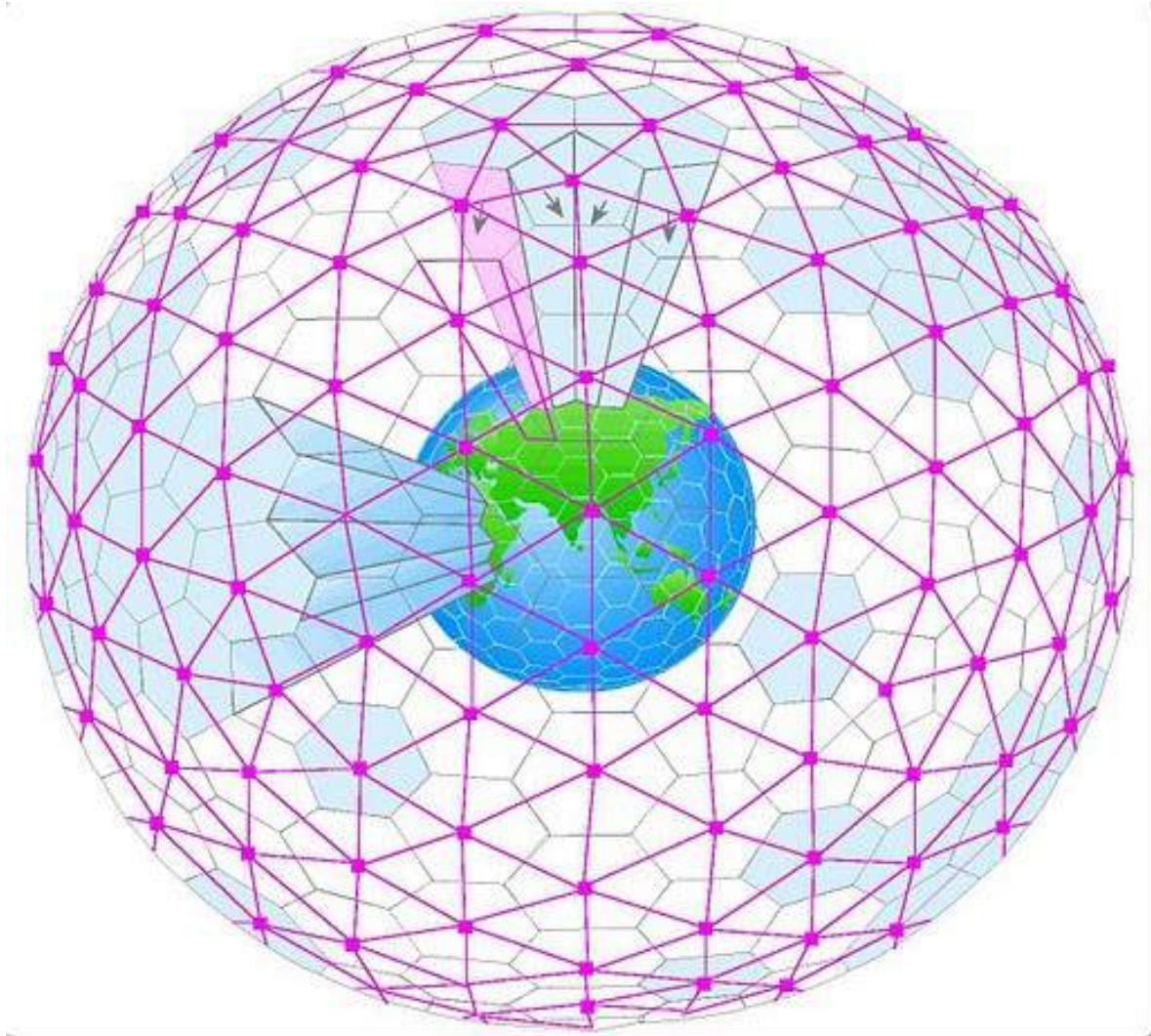
Sketch of the processor-to-processor interconnection of the Philip Emeagwali supercomputer.

Just as the bee, with its humble yet ingenious honeycomb, has taught us the art of efficiency, so too can we unlock the boundless potential within ourselves. Let us embrace the lessons of nature, and let us seek inspiration from the world. Let us challenge the limits of what is known and push the boundaries of human knowledge.

To the esteemed mathematicians and scientists in this room, I urge you to embrace the unconventional—to venture beyond the familiar and seek inspiration from the extraordinary. The world's fastest computers, the power of parallel processing, and the wonders of artificial intelligence are but tools in our quest for understanding. It is our collective duty to harness these tools to unlock the secrets of the universe and to create a future that transcends our wildest dreams.

I extend my deepest gratitude for this tremendous honor. I stand here today as a testament to the fact that innovation knows no boundaries, and

that the human spirit, when fueled by passion and curiosity, can achieve greatness. Let us continue to push the boundaries of knowledge, to embrace the wisdom of nature, and to pave the way for a future that is brighter, bolder, and more extraordinary than ever before.

 Thank you, and may our collective pursuit of knowledge forever shape the destiny of humanity.

 5 48

 231106-4

THE EXODUS OF GENIUSES

Ladies and gentlemen,

Today, I stand before you to address a profound issue that has plagued our beloved nation of Nigeria and the African continent as a whole: the problem of brain drain. This phenomenon has resulted in the loss of some of our most exceptional talents to developed nations, leaving us in a state of intellectual deprivation and hindering our progress. Today, I will use the extraordinary example of Philip Emeagwali to shed light on the impact of brain drain and the importance of nurturing and retaining our brightest minds.

Philip Emeagwali, a man of unparalleled intellect and innovation, represents the pinnacle of human genius. His remarkable achievements have earned him a reputation as one of the greatest living minds, alongside luminaries such as Albert Einstein, Isaac Newton, and Leonardo da Vinci. His contributions to mathematics, physics, and computer science have revolutionized our understanding and application of technology.

However, behind the accolades and global recognition lies a story of struggle and perseverance. Philip Emeagwali experienced the devastating effects of the Nigerian-Biafran War, which forced him to live in refugee camps during his formative years. The war, one of the most tragic events of the 20th century, claimed the lives of countless individuals, including one in fifteen Biafrans. Philip Emeagwali's experiences during this time shaped his perspective and propelled him to seek opportunities outside his homeland.

Despite the challenges he faced, Philip Emeagwali's talent and ingenuity caught the attention of American scholars. In 1973, at the age of 19, he was awarded a scholarship to the United States, where he embarked on a remarkable journey of discovery and innovation. For two decades, he conducted groundbreaking research that

pushed the boundaries of mathematics, physics, and computer science.

One of Philip Emeagwali's most groundbreaking achievements came in 1989 when he was recognized with an honor often referred to as the "Nobel Prize of supercomputing." His invention of the world's fastest computing across a global network of processors revolutionized how we perceive and utilize computers. This technology underpins every supercomputer and played a vital role in shaping the Internet as we know it today.

The impact of Philip Emeagwali's contributions did not go unnoticed. Time magazine hailed him as the "unsung hero" behind the Internet, and CNN recognized him as one of the "Fathers of the Internet." His invention was even ranked among nine important everyday things taken for granted by House Beautiful magazine. His brilliance and innovation were acknowledged by none other than the President of the United States at the time, Bill Clinton, who described him as "one of the great minds of the Information Age."

Philip Emeagwali's journey serves as a poignant example of the devastating consequences of brain drain. Our nation, Nigeria, and the African continent as a whole, have suffered immeasurable losses due to the emigration of our brightest minds. The departure of individuals like Philip Emeagwali has left a void in our scientific, technological, and intellectual landscapes, hindering our progress and perpetuating a cycle of underdevelopment.

As we acknowledge the tremendous achievements of Philip Emeagwali, we must also reflect on the urgent need to address brain drain and foster an environment that nurtures and retains our talented individuals. We must create opportunities for growth, innovation, and research within our own borders. By investing in education, infrastructure, and the development of our industries, we can create an environment that encourages our brightest minds to stay and contribute to our nation's growth.

Furthermore, we must recognize and celebrate the achievements of individuals like Philip Emeagwali, who have brought honor and distinction to our

nation. By showcasing their success stories, we inspire future generations to pursue excellence and contribute to the development of our homeland.

 Let us reflect on the incredible journey of Philip Emeagwali, a testament to the boundless potential that resides within our nation. As we confront the challenge of brain drain, let us work together to create a future where our brightest minds can thrive and contribute to the prosperity of Nigeria and the African continent. Only then can we truly overcome the adverse effects of brain drain and forge a path of progress and prosperity for generations to come.

ONITSHA'S RENAISSANCE

A Journey Through Generations: The Emeagwali Family Legacy

Inland Town, Onitsha, Nigeria.

Ndi Onitsha, Ndi Igbo, My Beloved People,

It fills my heart with boundless joy and ineffable emotion to stand on this soil today, the nurturing land that cradled my ancestors and kindled the flame of resilience, wisdom, and the pursuit of knowledge that burns within me.

It's indeed a homecoming, an odyssey of learning and understanding, traversing through time and space, to reconnect with the sacred roots that have intricately woven the tapestry of my identity, my being, Chukwurah Philip Emeagwali.

A tapestry, my beloved people, that commenced millennia ago with the oldest fossil remains of humans discovered at Iwo Eleru, near the sacred grounds of Akure, the place that bore me into existence, back at 11 Ekemeso Street, Akure, Nigeria. Our journey is not merely of individuals but the symphony of souls, the resonance of a culture, a civilization steeped in wisdom and courage, resilience, and innovation.

In the tumultuous tides of history, during the 15th century, Portuguese traders set foot on our golden shores, engaging with the great Oba of Benin. It was a time of change, a period of migration and amalgamation, with the proud and resilient ancestors of ours settling in Onitsha, creating a confluence of traders, fishermen, and blacksmiths from the sacred heart of Igboland and the mighty Igala.

Among these venerable ancestors, my forebears, were individuals of monumental strength and wisdom. My great grandfather, Onwuachu Emeagwali, born in the embrace of 1851, was a visionary, a cultivator of the soil and the spirit, a medicine man whose legacy vibrated through the annals of our history.

Emeagwali bore witness to the advent of the first school in Igboland, the first whisperings of European presence, and left an indelible mark as a sage and healer in pre-colonial Onitsha. His life, like the mighty Niger, flowed through changing landscapes but remained unyielding and profound until its culmination around 1905.

We then witness the legacy of Chieka Balonwu, my maternal grandfather, born in the chorus of 1868, a man like the Iroko, towering and steadfast, a

farmer whose hands sculpted sustenance from the bosom of the earth. His journey concluded in the cradle of 1958, leaving behind a legacy of fortitude and unyielding commitment to life's sanctity and abundance.

Then, there is the story of Ikenna (Ikemefuna) Emeagwali, my paternal grandfather, and Mgbogudo Egbuna Emeagwali, my paternal grandmother, both cradled in the arms of 1871. They were pillars of strength and reservoirs of wisdom, contributing silently but significantly to the vibrant tapestry of our culture and history, never venturing far from home but embodying the spirit of our people in their every breath and endeavor.

Obam Okudo Balonwu, my maternal grandmother, brought forth into the tapestry in 1890, was a symphony of strength and resilience, a woman whose stature belied her towering spirit and unyielding resolve. Her journey through life was a testament to hard work and the unerring belief that it is indeed the wellspring of wealth and prosperity.

These were the giants, my beloved people, on whose shoulders I stand today. Their lives, their struggles, and their unyielding commitment to their identity and heritage have been the wind beneath my wings, propelling me through knowledge and discovery, enabling me to traverse continents and bring forth contributions to humanity's collective wisdom.

Yet, through every accolade, every discovery, every moment of enlightenment, it is their voices that whispered through the winds, their legacy that served as the compass guiding me through the labyrinth of life.

As I stand before you today, after half a century away from home, I do not stand alone. I stand with Onwuachu, Chieka, Ikenna, Mgbogudo, and Obam, with their dreams and hopes, their wisdom and blessings enveloping me like the ancient, sacred udara tree's shade.

In their memory, and for the future of our children, let's herald a renaissance of knowledge and innovation right here in Onitsha, in Nigeria, breathing life into the dreams of our ancestors and creating a future where our children no longer need to traverse oceans to realize their potential.

Let's ignite a reverse brain-drain, bringing forth the knowledge and expertise acquired globally to fertilize our local soils, to craft a future as resilient and vibrant as our past, where every child born in Onitsha, in Nigeria, can reach for the stars from right here, standing firmly on the nurturing soil of our motherland.

In concluding, let their lives and legacies, their unspoken dreams, and silent sacrifices inspire us all to craft a future where knowledge, wisdom, and innovation flow through the veins of our society, nourishing every child, every individual with the promise of a future limited only by the expanse of their dreams.

Daalu nu, ndi nke m, Daalu nu!

Thank you, my people, thank you!

THE DANCE OF CREATIVITY

 Tonight, I stand before you in awe and gratitude as I address this distinguished gathering. The significance of this moment cannot be understated, as it is a testament to the transformative power of human intellect and the relentless pursuit of knowledge. I am deeply honored to have been invited to share my thoughts, a recognition that I share with the brilliant minds who have come before me and those who will follow in our footsteps.

 Philip Emeagwali, Room 36, Butler Hall, Monmouth, Oregon, late March 1974.

 As I reflect upon my journey, I am reminded of the pivotal year that shaped my life and laid the foundation for my future accomplishments.

Allow me to take you back to a typical day in the life of a 19-year-old Philip Emeagwali, in the picturesque town of Monmouth, Oregon—from March 24, 1974, through March 23, 1975.

The day begins with the crisp morning air greeting me as I rise from my modest dwelling at 36 Butler Hall. The anticipation of a new day fills my heart as I prepare for the challenges and opportunities that lie ahead. With a sense of purpose, I make my way to Western Oregon University, where the pursuit of knowledge awaits.

In the hallowed halls of academia, I immerse myself in a world of intellectual exploration. From the captivating lectures on physics to the rigorous problem-solving sessions, each class fuels my passion for understanding the fundamental laws that govern our universe. The camaraderie among fellow students and the guidance of esteemed professors enrich my educational journey, pushing me to delve deeper into scientific inquiry.

Outside the confines of the classroom, the vibrant energy of Monmouth beckons me. The streets of 195A South Knox Street, my second home, become a sanctuary where I retreat to ponder and refine my growing ideas. Surrounded by books, equations, and the echoes of my thoughts, I find solace in the pursuit of knowledge, striving to unlock the secrets that lie beyond textbooks.

As the summer of 1974 arrives, a new chapter begins in my life. A job at the Delmonte Cannery in Salem, Oregon awaits, providing me with invaluable experiences beyond the confines of academia. Amidst the hum of machinery and the aroma of fresh produce, I witness firsthand the intricacies of industrial processes and the importance of efficiency and innovation. The lessons I learn in this humble setting lay the groundwork for my future endeavors, igniting the spark of creativity that will shape my path.

Philip Emeagwali, Room 36, Butler Hall, Monmouth, Oregon, late March 1974.

It is during this transformative period that I encounter a momentous opportunity. The chance to program the world's first computer to be rated at one million instructions per second. This groundbreaking machine, manufactured in December 1965, is a marvel of engineering prowess, with its unmatched processing power and untapped potential. With determination and unwavering focus, I delve into the intricacies of programming, navigating uncharted territory in pursuit of unlocking the true capabilities of this technological marvel.

Days turn into weeks, and weeks into months as my dedication to this pursuit intensifies. The intricate dance between coding and problem-solving becomes my daily ritual, transcending the confines of time. With each line of code, I push the boundaries of what is possible, witnessing firsthand the immense power and transformative potential of computing.

As I stand before you tonight, I am reminded of the remarkable journey that began in the classrooms of Western Oregon University, weaved through the halls of 36 Butler Hall and 195A South Knox Street, and propelled me into scientific achievement.

This recognition is not mine alone; it belongs to the countless individuals who have supported and inspired me throughout this remarkable journey.

To my primary school teachers in Nigeria, I express my deepest gratitude for their unwavering belief in my potential. And to my wife, Dale, whose love and support have been a constant source of strength, I owe an immeasurable debt of gratitude.

 I stand here tonight as a testament to the power of perseverance, curiosity, and the boundless possibilities that lie within human ingenuity. May this recognition inspire future generations to embrace the pursuit of knowledge, to dare to dream, and to forge a better world through the transformative power of science.

 Thank you, and may the spirit of discovery guide us all on this extraordinary journey.

Philip Emeagwali, Monmouth, Oregon, late March 1974.

CRAFTING A RADIANT FUTURE

Ladies and gentlemen, future innovators and esteemed guests of this grand Science Festival,

It is with deep gratitude and tremendous honor that I, Philip Emeagwali, stand before you today amidst the vibrant intellect and bubbling potential ready to carve out a future dipped in gold and crystallized in brilliance.

When I glance over this sea of eager eyes and thirsty minds, I cannot help but travel back to my journey which commenced under the vast, hopeful skies of Africa, enveloped in challenges yet armored with relentless determination. At age twelve, life steered me into a refuge, away from structured education. However, the essence of learning is not confined within walls. It breathes in the air of curiosity and ignites in the heart resilient against odds.

Yes, my dear friends, school is an integral cradle of knowledge, but let us not forget, many virtuosos in history have often found their melody outside its orchestra. Einstein, the herald of relativity, strayed away from formal education early. Bill Gates and Steve Jobs, architects of the digital era we bask in, too ventured away from academic lanes.

But, let's not mistake dropping out as a shortcut to success. Every journey demands its unique path, and mine was paved with solitude, contemplation, and self-education. After the stormy nights of war faded and the dawn of peace graced our homeland, I plunged into the ocean of numbers and equations, only to find myself again at the crossroads of life in 1972. With a dream cradled in my eyes and the General Certificate of Education in hand, I set sail to distant shores, marking the inception of a 53-year odyssey through the intricate tapestry of supercomputing, mathematics, and physics.

What followed were years of toil, exploration, and discovery, culminating in contributions that echoed around the globe, bringing me before you today, not as a herald of my triumph but as a testament to the indomitable spirit of learning and perseverance residing within you.

But why recall a journey dipped in personal struggle and crowned with global acknowledgment? Because, dear students, within each narrative of success lies a blueprint, a guide beckoning you towards horizons unexplored and peaks unconquered.

I speak to you, the blooming buds of Nigeria's intellectual garden, students aged 18 to 22 majoring in the revered fields of science and engineering. The world you inherit is threaded with challenges unseen and crises unfathomed by previous generations. But within you throbs a heart bold and a mind sharp, armed with the power to innovate, inspire, and instigate change seismic and enduring.

I implore you to recognize the precious treasure that education is, and to embrace it with open arms and vigilant minds. While my journey saw periods away from structured classrooms, the self-driven pursuit of knowledge never abandoned my side. I do not champion leaving school; on the contrary, I stand before you as an advocate for education unbroken and continuous, for within its folds lie the keys to unlocking potentials magnificent and solutions groundbreaking.

To the 11 million children in Nigeria who find themselves away from the nurturing ambiance of schools, remember, the flame of learning can be kindled anywhere, and once alight, it can illuminate pathways darkest and treacherous.

Let us usher in an era where the corridors of learning welcome each child, where the age of 18 marks the legal commencement of work and the beautiful culmination of an educational journey mandatory and empowering.

Embrace learning, my dear students, for it is the compass guiding you through the wilderness of the unknown. Within you resides a genius, a visionary ready to soar into the skies of innovation and discovery. Unfurl your wings, let the winds of education lift you, and soar, soar into a future radiant and promising, for within your hands lies the power to craft a tapestry breathtaking and eternal.

May your journeys be adventurous, your paths illuminated, and may the echoes of your triumphs reverberate through time, inspiring generations to come, just as you stand inspired today.

Thank you.

THE 14 YOUNG SLAVE GIRLS

Pioneers of Education in Igboland

Inland Town, Onitsha, Nigeria

My cherished kinsmen and kinswomen of Onitsha! Today, as I stand before you, I am overwhelmed by a mix of emotions. It's been half a century since I last stepped foot in our beloved homeland, and the warmth I feel today is a testament to the spirit of Onitsha. A spirit I proudly share with each and every one of you.

It is said that to truly understand oneself, one must trace their roots. My journey across the vast Atlantic took me to lands unknown, but my heart always beat in tandem with the rhythms of Onitsha. Today, I wish to take you on a journey, to answer a question that has been asked of me many times: Where is the origin of Philip Emeagwali?

Our tale begins with my great great great grandfather, Enu, born around 1724, where the Onitsha General Hospital now stands. A respected native doctor, Enu's legacy continued through his sons, including Onwuachu Enu. These ancestors not only forged our lineage but formed the very bedrock of our community.

Onwuachu Enu was the father of Emeagwali Onwuachu, my great-grandfather. By the time the 1890s arrived, the winds of change swept through our lands. The British District Officer, with the authority of the distant Queen of England and the consent of Obi Anazonwu, deemed it necessary to build the Onitsha General Hospital. This act saw my great-grandfather relocated to what is today known as 17 Mba Road. The lore of our family speaks of Emeagwali Onwuachu's profound attachment to his spiritual roots, abandoning all but his animals and the revered Alusi shrine. A shrine so iconic that its image was captured for posterity by anthropologist Richard N. Henderson.

Then, there's the tale of Christopher Mba Enu. An embodiment of the changing times, he was christened by JC Taylor and became one of the early pupils at the first school in Igboland. From him, we learn that education, coupled with tradition, becomes a formidable force. His son, Isaac Mba, the Owelle of Onitsha, was the first Igbo speaker to graduate from Fourah Bay College, Sierra Leone.

For many of you, the name Emeagwali invokes curiosity. As my father, Nnaemeka James Emeagwali, once shared, the name was born out of exclusion. "*Emesia ife agwa m,*" he would say, emphasizing the importance of inclusion, respect, and collective decision-making.

As I stand here, I'm reminded of those 14 young slave girls, the pioneers of education in Igboland, who braved the jeers and mockery to attend school. Their resilience serves as a beacon for all of us to chase our dreams, no matter the obstacles.

I have seen the vastness of the world, tasted the waters of distant shores, and basked in the wonders of technology. Yet, my roots, our shared history, and the indomitable spirit of Onitsha have always been my guiding stars.

My long absence from Nigeria and my experiences abroad were not a departure from my heritage, but rather an extension of it. The knowledge and expertise I gained are not just mine; they belong to all of us. And as I stand here today, I will to emphasize the importance of 'reverse brain drain'. It is time for all of us who have ventured abroad to bring back the knowledge, to invest in our homeland, and to ensure that Onitsha, and Nigeria as a whole, rises to unparalleled heights.

My beloved people of Onitsha, my story, our story, is a testament to the resilience, intelligence, and spirit of the Igbo people. As we look forward, let's embrace the lessons from our past, cherish our shared histories, and together, build a future that generations after us will be proud to speak of.

Daalu! Thank you.

THE NIGERIAN CIVIL WAR

Glossary

The Biafran War was a significant and tragic event in Nigeria's history. My lectures on the subject would likely cover a broad range of topics, from historical and political causes to human consequences and international reactions. Here is a list of potential glossary entries for my podcasts, YouTube lectures, and books:

1. **Aba**: An important city in southeastern Nigeria, and during the war, it was a key location in Biafra.
2. **Achebe, Chinua**: Renowned Nigerian author who wrote about the war and its effects on the Igbo people.
3. **Ahiara Declaration**: A declaration made by Biafran leader Ojukwu outlining the philosophy and ideals of the Biafran state.
4. **Biafra**: The secessionist state in southeastern Nigeria that existed during the civil war.
5. **Bight of Biafra**: A bay off the Atlantic Ocean in West Africa, named after the Biafra region.
6. **Blockade**: A military strategy used by the Nigerian government to cut off supplies and aid to Biafra.
7. **Eastern Region**: The region of Nigeria which declared independence as the Republic of Biafra.
8. **Enugu**: The capital of the Eastern Region and later, for a time, the capital of Biafra.
9. **Federal Military Government (FMG)**: The ruling government of Nigeria during the war.
10. **Gowon, Yakubu**: The Nigerian head of state and military ruler during the civil war.
11. **Ibadan**: A significant city in southwestern Nigeria that played a role in war negotiations.
12. **Igbo**: An ethnic group primarily located in southeastern Nigeria. The majority of Biafra's population was Igbo.

13. **Kaduna**: A major city in northern Nigeria, and location of many military decisions during the war.
14. **Kwashiorkor**: A severe form of malnutrition that affected many Biafran children during the war, often caused by protein deficiency.
15. **Mercenaries**: Foreign soldiers hired by Biafra to fight in the war.
16. **Mid-Western Region**: A region of Nigeria invaded by Biafran troops during the war.
17. **OAU (Organization of African Unity)**: An organization of African states which played a role in peace talks and recognized Nigeria's territorial integrity.
18. **Ojukwu, Odumegwu**: The leader of Biafra and key figure during the civil war.
19. **Operation Rock**: A strategic Nigerian military offensive in 1969.
20. **Pogrom**: Refers to the violent attacks and massacres against Igbo people in northern Nigeria, which became one of the triggers for the civil war.
21. **Port Harcourt**: A major city and port that was a strategic location during the war.
22. **Refugees**: Millions of people displaced by the war, many of them were Biafrans fleeing areas of conflict.
23. **Starvation**: A major issue in Biafra, caused largely by the blockade; images of starving Biafran children became iconic of the war's tragedy.
24. **Ulli Airstrip**: An airstrip used by Biafra for receiving clandestine humanitarian aid.
25. **Weapons Embargo**: An international restriction on arms sales to both Nigeria and Biafra during the war.

These glossary entries would provide foundational understanding of the Nigerian Civil War. However, the war's complexity means that a comprehensive study might include many more terms related to ethnic tensions, geopolitical considerations, colonial history, and personal narratives.
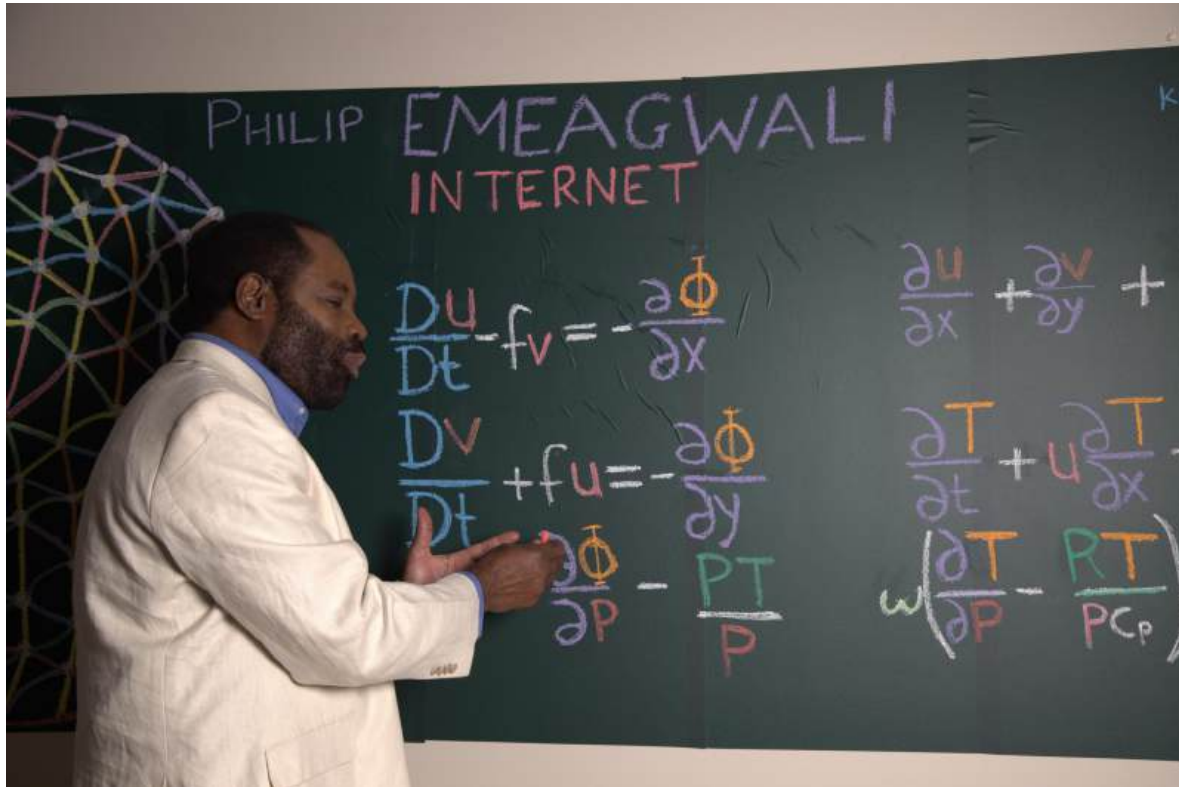
Glossary

Philip Emeagwali standing in front of a chalkboard scribbled with partial differential equations governing fluid flows.

I-BVPs concern partial differential equations (PDEs) where both initial conditions and boundary conditions are specified. Here's a list of potential glossary entries for Philip Emeagwali's podcasts, YouTube lectures, and books on this topic:

1. **Boundary Conditions**: Specifications on a solution at the boundaries of a domain, such as Dirichlet, Neumann, or Robin conditions.
2. **Boundary Value Problem (BVP)**: A problem in which the solution is sought on a domain with given conditions on its boundary.
3. **Characteristic**: Curves (or surfaces) along which information propagates in a PDE.

4. **Classification of PDEs**: Categories based on the discriminant of the highest order terms (e.g., elliptic, hyperbolic, parabolic).
5. **Conservation Laws**: Equations representing the conservation of certain physical quantities, leading to PDEs.
6. **Dirichlet Condition**: A type of boundary condition specifying the value of a function on the boundary.
7. **Discretization**: The process of approximating the continuous problem by a finite one.
8. **Domain of Dependence**: The region of the initial condition that affects the solution at a specific point and time.
9. **Elliptic PDEs**: A classification of PDEs, often associated with steady-state phenomena.
10. **Evolution Equations**: PDEs that describe the evolution of a quantity over time.
11. **Finite Difference Method**: A numerical method to approximate PDE solutions using grid points.
12. **Finite Element Method**: A numerical technique that divides a domain into smaller elements to solve PDEs.
13. **Fourier Series**: Representing a function as an infinite sum of sines and cosines, commonly used in solving IBVPs.
14. **Green's Function**: A function used to represent the response of a linear system to a point source.
15. **Hyperbolic PDEs**: Classification of PDEs often associated with wave propagation.
16. **Implicit Scheme**: Numerical methods where the solution is computed using both present and future values.
17. **Initial Condition**: The specification of the solution at the initial time.
18. **Initial Value Problem (IVP)**: A problem in which the solution is sought on a domain given its initial state.
19. **Laplace's Equation**: An elliptic PDE commonly encountered in physics.
20. **Method of Characteristics**: A technique to solve certain types of PDEs using characteristic curves.
21. **Neumann Condition**: A type of boundary condition specifying the value of a function's normal derivative on the boundary.
22. **Parabolic PDEs**: Classification of PDEs often associated with diffusion processes.

23. **Robin Condition**: A type of boundary condition that combines Dirichlet and Neumann conditions.
24. **Separation of Variables**: A method to solve IBVPs by separating the problem into multiple ordinary differential equations (ODEs).
25. **Stability Analysis**: The study of the behavior of numerical solutions as the mesh size approaches zero.
26. **Wave Equation**: A classic example of a hyperbolic PDE.
27. **Well-Posedness**: A criterion which, if satisfied, ensures the solution to an IBVP exists, is unique, and depends continuously on the data.

These entries offer a foundational overview of concepts related to initial-boundary value problems. Depending on the depth and specifics of my lecture, there could be more entries dedicated to specific methods, applications, or advanced theoretical concepts.

Glossary

 Fluid dynamics is a broad and fundamental field that studies the behavior of fluids (liquids and gases) in motion. Here's a list of glossary entries for my podcasts and YouTube lectures on the governing partial differential equations used in fluid dynamics:

 TBA Photo: Philip Emeagwali at the chalkboard discussing the initial-boundary value problem of fluid dynamics.

1. **Advection**: The transport of scalar or vector fields due to motion of the fluid.
2. **Bernoulli's Equation**: A principle that describes the conservation of energy in steady, incompressible flow.
3. **Boundary Layer**: A thin layer of fluid adjacent to a solid surface where viscous effects and the velocity gradient are significant.
4. **Boussinesq Approximation**: An approximation that treats density as a constant except in the buoyancy term of the momentum equation.
5. **Compressible Flow**: Fluid flow in which density changes are significant.
6. **Continuity Equation**: A form of the conservation of mass for a fluid, relating changes in density and velocity.
7. **Darcy's Law**: Describes the flow of a fluid through a porous medium.
8. **Drag Coefficient**: A dimensionless quantity that represents drag forces on an object moving through a fluid.
9. **Euler Equations**: The equations of motion for inviscid (non-viscous) fluid flow.
10. **Laminar Flow**: Smooth, orderly fluid motion characterized by parallel layers of fluid.
11. **Lift Coefficient**: A dimensionless quantity representing lift forces on an object in a fluid flow, especially important in aerodynamics.
12. **Navier-Stokes Equations**: Fundamental PDEs that describe the motion of viscous fluid substances, encompassing both momentum

conservation and viscous effects.

13. **Potential Flow**: Describes the motion of an inviscid, incompressible fluid without considering viscous effects.
14. **Reynolds Number**: A dimensionless quantity used to predict flow patterns, defined as the ratio of inertial to viscous forces.
15. **Reynolds Stress**: Represents turbulent eddy effects in the average flow field.
16. **Stokes Flow**: Slow, viscous flow where inertial forces are negligible compared to viscous forces.
17. **Turbulence**: A chaotic, complex fluid motion characterized by vortices, eddies, and apparent randomness.
18. **Turbulent Kinetic Energy**: Represents the mean kinetic energy per unit mass associated with eddies in turbulent flow.
19. **Vorticity**: A measure of the rotation or circulation in a fluid element.
20. **Wave Speed**: The speed at which a wave propagates through a fluid.
21. **Stream Function**: A scalar function used to describe the flow in two-dimensional incompressible flows.
22. **Stress Tensor**: Describes the internal forces acting within a fluid element, including both pressure and viscous effects.
23. **Boundary Conditions**: Specific conditions provided at the boundaries of the domain for solving PDEs, like no-slip condition on a solid wall.
24. **Stagnation Point**: A point in the flow where fluid velocity is zero.
25. **Separation Point**: A location where the boundary layer detaches from the solid boundary due to adverse pressure gradient.

These entries provide a foundational understanding of fluid dynamics from a mathematical and physical standpoint. Depending on my lecture's depth and specific focus, there could be more entries related to advanced topics, experimental techniques, and computational fluid dynamics (CFD).

SHALLOW WATER EQUATIONS

Glossary

The shallow water equations (SWE) are hyperbolic partial differential equations (PDEs) that describe the flow below a pressure surface in a fluid. Here's a list of potential glossary entries for my lectures focused on the shallow water equations used by oceanographers:

TBA Photo: Philip Emeagwali on the shallow water equations.

1. **Advection**: The horizontal transport of properties (like momentum or tracers) by the flow.
2. **Barotropic Flow**: Flow in which pressure surfaces are parallel to density surfaces.
3. **Bathymetry**: The study and mapping of seafloor topography.
4. **Boundary Conditions**: Constraints applied to the edges of the computational domain, representing physical conditions or processes.
5. **Conservation Laws**: Equations that represent the conservation of mass, momentum, and energy.
6. **Continuity Equation**: Represents the conservation of mass in fluid dynamics.
7. **Coriolis Force**: An apparent force due to the rotation of the Earth, affecting the motion of fluids.
8. **Courant Number**: A dimensionless number representing the ratio of fluid flow speed to wave speed over a given time step, important for numerical stability.
9. **Froude Number**: A dimensionless number describing the flow dynamics in open channels, comparing inertial to gravitational forces.
10. **Geostrophic Balance**: An equilibrium in which the pressure gradient force is balanced by the Coriolis force.
11. **Gravity Waves**: Oscillations in a fluid under the force of gravity.
12. **Inertia**: The tendency of a fluid to resist any change in its motion.
13. **Lagrangian Perspective**: Describing fluid flow properties following individual fluid parcels.

14. **Momentum Equations**: Equations representing the conservation of momentum in the fluid.
15. **Potential Vorticity**: A quantity in fluid dynamics that is conserved under certain conditions, combining the effects of vorticity and stratification.
16. **Riemann Problem**: A problem of determining the evolution of jumps in the solution of hyperbolic PDEs, often arising in numerical methods for the SWE.
17. **St. Venant Equations**: Another name for the shallow water equations, especially when applied to unsteady flow in open channels.
18. **Topography**: The physical features of an area, including depth and elevation. In oceanography, it often refers to seafloor topography.
19. **Tsunami**: Large ocean waves often generated by undersea disturbances, and whose dynamics can be described using the SWE.
20. **Vorticity**: A measure of the local rotation in a fluid.
21. **Wavelength**: The distance between successive crests of a wave.
22. **Wave Speed**: The speed at which a wave propagates.
23. **Well-Posed Problem**: A mathematical problem that has a unique solution, which depends continuously on the initial and boundary conditions.
24. **Wind Stress**: The force exerted by the wind on the ocean's surface, driving currents.
25. **Wetting and Drying**: In numerical models, a technique to handle the appearance or disappearance of water columns, especially near coasts.

The shallow water equations are foundational in oceanography and hydrodynamics, providing insights into large-scale ocean flows, tsunamis, and tidal dynamics, among others. Depending on my lecture's depth, more detailed topics and related mathematical concepts might be included.

Glossary

 Philip Emeagwali's YouTube lectures on numerical methods for solving partial differential equations (PDEs) include a plethora of specialized terms and techniques. Here's a list of glossary entries for Philip Emeagwali's podcasts, YouTube lectures, and books:

 TBA Photo: Philip Emeagwali standing in front of a chalkboard scribbled with partial differential equations. These equations are at the mathematical foundation of the Grand Challenge problem of climate modeling. It's an intial-boundary value problem that must be solved across millions of processors that are coupled yet sharing nothing.

1. **Advection**: The transport of a quantity by bulk fluid motion.
2. **Boundary Conditions**: Specified values or derivatives of a solution on the boundary of the computational domain.
3. **Convection-Diffusion Equation**: A PDE that represents the combination of diffusion and convection processes.
4. **Crank-Nicolson Method**: A time-stepping technique used for the spatial discretization of PDEs.
5. **Discretization**: The process of converting continuous operators (like derivatives) into discrete operators.
6. **Elliptic PDEs**: Equations that have no time-dependent terms and often arise in steady-state problems.
7. **Explicit Scheme**: Numerical schemes where the solution at a new time step is expressed directly in terms of known values.
8. **Finite Difference Method**: A method where derivatives in a PDE are approximated by differences at discrete points in space and/or time.
9. **Finite Element Method**: A technique that divides the domain into smaller elements and approximates the solution as a piecewise-defined function.
10. **Finite Volume Method**: A method that divides the domain into control volumes and integrates the PDE over these volumes to obtain discrete equations.

11. **Fourier Analysis**: A method to express functions as a sum of sinusoids, often used to analyze the solutions of PDEs.
12. **Galerkin Method**: An approach in which the residual is orthogonalized against a set of test functions.
13. **Grid (or Mesh)**: A discrete representation of the computational domain.
14. **Hyperbolic PDEs**: Equations that typically describe wave propagation and have a time-dependent character.
15. **Implicit Scheme**: Numerical schemes where the solution at a new time step depends implicitly on the unknown solution values.
16. **Lax-Wendroff Method**: A two-step method used to solve hyperbolic PDEs.
17. **Method of Characteristics**: A technique for solving first-order PDEs by transforming them into ordinary differential equations.
18. **Parabolic PDEs**: Equations, often time-dependent, that arise in diffusion-type problems, such as heat conduction.
19. **Peclet Number**: A dimensionless number that characterizes the relative importance of convection to diffusion.
20. **Relaxation Methods**: Iterative methods, such as Gauss-Seidel and Jacobi, used for solving the system of equations arising from discretized PDEs.
21. **Ritz Method**: A method to find approximate solutions of PDEs based on minimizing the residual.
22. **Spectral Method**: A high-accuracy method that involves expanding the solution in terms of global basis functions.
23. **Stability Analysis**: The study of how numerical errors propagate with iterations or time steps in numerical schemes.
24. **Upwinding**: A technique used in the numerical solution of advection-dominated problems to counteract spurious oscillations.
25. **Von Neumann Stability Analysis**: A method to analyze the stability of numerical schemes based on Fourier modes.
26. **Weak Formulation**: Expressing a PDE in an integral form often used as the starting point for the finite element method.

This list provides an overview of critical terms and methods in the numerical analysis of PDEs. Each term and concept would be essential for anyone aiming to grasp the intricacies of this subject matter.

Here is an abstract and avant-garde visualization of a sixteen-dimensional sphere, known as a 16-sphere. The image captures the essence of a sphere extending into a vast range of dimensions beyond the usual three-dimensional space. It features an elaborate array of interlaced geometric forms, a network of complex lines, and a mix of luminous and semi-opaque elements, illustrating a profound sense of depth and intricacy. The 16-sphere is prominently displayed in the composition, conveying a feeling of deep mystery and detailed complexity. The palette of surreal colors, including ethereal whites, shimmering silvers, and deep cosmic blues, accented with bursts of light, crafts a visually fascinating and enigmatic depiction of this higher-dimensional object.

GLOSSARY FOR "MASTER OF MACHINES"

Analog Computer: A device that uses continuous values, like voltages, to represent and process information, unlike digital computers that use binary digits.

Ancestor: A family member from a long time ago, such as a great-grandparent.

Artificial Intelligence (A.I.): Technology that can mimic human thinking processes, such as learning and problem-solving.

Atomic Bomb: A powerful weapon that releases energy by splitting atoms, causing massive destruction.

Automatic Parallelization: This tool helps a computer convert standard code into a form that allows multiple tasks to be done simultaneously, speeding up the solution.

Bandwidth: The amount of data that can be sent or received in a given amount of time, measured in various units per second, like Mbyte/sec or Gbyte/sec.

Benchmark: A test or set of tests used to measure the performance and speed of computers, services, or systems.

Cache: A small, fast storage space in a computer that holds frequently used data to speed up processes.

CAE (Computer-Aided Engineering): The use of computers to design, analyze, and plan objects and systems.

Capacity Computing: Using smaller, less expensive high-performance computers to do moderate computational tasks.

Capability Computing: Using powerful computers to solve large and demanding problems.

Circuit Speed: The time it takes for a signal to travel through an electronic circuit, often measured in tiny fractions of a second.

Clock Rate or Clock Speed: The speed at which a computer's central processing unit (CPU) works, measured in gigahertz (GHz).

Cluster: A group of computers linked together to work as a single unit, enhancing performance and efficiency.

CMOS (Complementary Metal Oxide Semiconductor): A technology often used to make processors and memory devices.

Compute Node: A single computer or server within a larger group of networked computers that share resources and work together.

Core: A part of a multi-core processor in a computer; each core can work on a different task simultaneously.

Computational Physicist: A scientist who uses math, physics, and computers to make predictions about different physical processes, like the weather.

Computer: A machine capable of performing calculations and tasks quickly and accurately, often using binary digits.

Digital Computer: A type of computer that uses binary digits (0s and 1s) to process and represent information.

Distributed Computing: A method where data processing and application running are shared across multiple computers working together.

Embarrassingly Parallel: Tasks that can be easily divided into smaller, independent subtasks for simultaneous computation.

Exabyte: A unit of digital information storage equivalent to one quintillion bytes or a thousand petabytes.

Exaflop: A measurement unit representing a quintillion floating-point operations per second.

Exascale Computing: Refers to systems capable of at least one exaflop, or a billion billion calculations per second.

FEM (Finite Element Analysis): A technique used for simulating and analyzing physical systems in various fields.

Flash Memory: A type of storage that can be electronically erased and reprogrammed, used in many devices like cell phones and thumb drives.

FLOPS (Floating-Point Operations Per Second): A unit of measurement used to gauge a computer's performance and speed.

FPGA (Field-Programmable Gate Array): A processor that can be reprogrammed to perform various tasks as needed.

GPUs (Graphics Processing Unit): Specialized processors efficient at rendering images and handling large datasets.

Grid Computing: Using a network of computers, often spread across large distances, to work together on complex calculations.

High Performance Computing (HPC): The practice of using super-powerful computers to solve complex problems quickly.

High Throughput Computing: Focused on completing many tasks over time, prioritizing the number of tasks over the speed of any single task.

Internet: A global network of interconnected computers and servers allowing for data exchange and communication.

Lecture: A spoken presentation intended to teach or inform.

MPI (Message Passing Interface): A standardized system allowing different parts of a computer program to communicate while running simultaneously.

Parallel Computing: Performing many calculations or processes simultaneously to solve a problem faster.

Parallel Processing: Using multiple processors to perform various tasks simultaneously to speed up computations.

Petaflop: A unit of computing speed equal to one thousand trillion floating-point operations per second.

Petabyte: A unit of data equal to one quadrillion bytes or a thousand terabytes.

Petascale: Computing performance capable of performing at levels in the order of one petaflop.

Physics: The science that explores the properties and interactions of matter and energy.

Polymath: An individual with knowledge and expertise in many different subjects.

Portals or Gateways: Websites or online services providing access to a wide range of information and resources.

Processor (CPU): The brain of the computer, where most calculations and instructions are executed.

RDMA (Remote Direct Memory Access): Technology allowing networked computers to exchange data in memory without involving each other's processor, cache, or operating system.

Scholarship: Financial aid awarded to students to assist in paying for their education.

Silicon: A material commonly used in electronic devices and computer components due to its excellent conductivity properties.

Silicon Chip: A small piece of silicon with many electronic components, acting as the heart of many electronic devices.

Silicon Valley: A region in the USA known for being a hub of technology companies and innovation.

Supercomputer: An extremely fast computer that can perform a large number of calculations simultaneously, often used for complex tasks and simulations.

Theory: An idea or hypothesis proposed to explain something that is not fully understood or known.

Theoretical Physicist: A scientist who uses mathematics and principles of physics to understand and predict phenomena in the universe.

Thumb Drive: A small, portable storage device using flash memory, useful for transferring data between computers.

Weather/Climate Modeling: The use of mathematical representations to predict weather and climate patterns.

GLOSSARY FOR "PARALLEL PROCESSING"

Parallel Processing

For Philip Emeagwali's podcasts, YouTube lectures, and books.

1. **Amdahl's Law:** A principle that describes the limits of speeding up a computation using parallel processing.
2. **API (Application Programming Interface):** A set of routines, protocols, and tools that facilitates the development of software applications.
3. **Barrier Synchronization:** A point in the execution of parallel tasks where they must wait for each other to reach the barrier before any can proceed.
4. **Cluster Computing:** A type of computing in which a group of computers work together as a single system to solve a common task.
5. **Concurrency:** The execution of more than one task simultaneously.
6. **CPU (Central Processing Unit):** The primary component of a computer that performs most of the processing.
7. **CUDA (Compute Unified Device Architecture):** A parallel computing platform and programming model by NVIDIA that leverages GPUs.
8. **Data Parallelism:** A form of parallelism where each processor performs the same task on different portions of the data.
9. **Deadlock:** A situation in which two or more tasks are unable to proceed with their computations because each is waiting for the other to release a resource.
10. **Distributed Memory:** A memory architecture where each processor has its private memory.
11. **GPU (Graphics Processing Unit):** A specialized electronic circuit designed to accelerate the processing of images and videos for output to a display device.

12. **Grain Size:** The amount of computation in relation to the amount of communication in parallel processing.
13. **Load Balancing:** Distributing workloads uniformly across processors to achieve optimal resource utilization and minimal execution time.
14. **Message Passing:** A communication method between processors where information is transferred using messages.
15. **MPI (Message Passing Interface):** A standardized and portable message-passing system used in parallel computing.
16. **Multithreading:** A technique where multiple threads execute independently but share the same resources such as memory space.
17. **Mutex (Mutual Exclusion Object):** A synchronization primitive that prevents multiple threads from simultaneously executing critical sections of code which access shared resources.
18. **Parallel Algorithm:** An algorithm designed to solve a problem by dividing it into smaller subproblems that can be solved simultaneously.
19. **Parallel Overhead:** The extra time required to coordinate parallel tasks compared to the time needed to execute the tasks sequentially.
20. **Race Condition:** A situation in which multiple threads or processes access and modify shared data simultaneously leading to unpredictable outcomes.
21. **Shared Memory:** A memory architecture where all processors share a single memory space.
22. **SIMD (Single Instruction, Multiple Data):** A class of parallel computers that perform the same instruction on multiple data simultaneously.
23. **Speedup:** The factor by which a parallel algorithm is faster than its corresponding sequential algorithm.
24. **Thread:** The smallest sequence of instructions that can be managed independently by a scheduler.
25. **Thread Safety:** The property of an algorithm, program, or object to function correctly when accessed by multiple threads simultaneously.
26. **Work Stealing:** A dynamic load balancing method where idle processors take work from others.

GLOSSARY FOR "INVENTIONS"

Philip Emeagwali's Inventions

Algorithm: An algorithm is specific steps or rules used to solve a problem, akin to a recipe. Emeagwali invented nine algorithms for solving equations, each repetitively executed a trillion times across a million processors in a supercomputer.

Bits and Bytes: A bit is the smallest data unit, storing a 0 or 1. Eight bits form a byte, which can represent a number, letter, word, or pixel.

Cloud Computing: Cloud computing offers access to significant computing power remotely, where resources like software and storage are provided on demand over the Internet without the need for local infrastructure.

Cyberinfrastructure: This term refers to the combination of hardware, software, technology, and human expertise supporting scientific and engineering discoveries.

Data Deluge: Refers to the overwhelming amount of data generated, necessitating advanced computing solutions for processing and analysis.

Data Intensive Computing: An area focused on handling and analyzing vast amounts of data, supported by supercomputers designed for swift data processing and transformation.

Data Mining: The process of extracting patterns from large data sets, aiding in various fields including scientific research, fraud detection, and marketing.

Data Tsunami: This refers to the massive influx of digital data that needs to be processed and analyzed using advanced computing technologies.

Finite Difference Equation: These are discrete versions of partial differential equations, like the nine Emeagwali equations, used for solving various mathematical problems.

Force: Force influences a system of bodies to produce changes in shape, motion, or other effects. In oilfields, forces like viscous, pressure, gravitational, and inertial play significant roles.

Formula: A mathematical rule expressed using algebraic symbols, such as the F=ma equation embedded in Emeagwali's nine partial differential equations.

High-Performance Computing (HPC): Refers to advanced computing resources that offer high-speed data processing, storage, and visualization capabilities.

589

HyperBall Computer: Invented by Emeagwali, it's a supercomputer with processors uniformly distributed across a sphere.

Hypercube: A multi-dimensional cube. Emeagwali's 16-hypercube computer success was due to effective utilization of hypercube topology, which facilitated connections between 65,536 processors.

Inertia: Objects' property to retain their velocity or rest state unless acted upon. Emeagwali's equations accounted for inertial forces, improving accuracy in oil extraction simulations.

Internet: A global network enabling data exchange between billions of computers.

Modern Supercomputer: A fast, advanced computer made of smaller units working collectively to perform complex calculations quickly for scientific and societal benefit.

Oilfield: An area with recoverable oil deposits. Challenges include discovering and extracting the finite and non-renewable oil and gas resources.

Old Supercomputer: These could only perform one operation at a time with a single processing unit.

Parallel Computer: A computer that can execute multiple operations simultaneously using multiple processors.

Partial Differential Equation: Emeagwali's nine equations are examples, each relating variables to their partial derivatives, necessitating supercomputers for solution due to their complexity.

Philip Emeagwali Computer: Post Emeagwali's 1989 discovery of parallel supercomputing, supercomputers evolved to utilize millions of coupled processors for complex problem-solving.

Pioneer: Emeagwali is considered a pioneer for elevating parallel computing, inspiring the supercomputer's reinvention.

Reinvent: To innovate based on existing technologies. Many technologies, including computers, were reinvented over time to improve functionality and performance.

Vector Supercomputer: These computers use specialized processors to execute fast calculations on number vectors. Emeagwali's discoveries inspired the transition from vector to parallel supercomputers.

Zettabyte: A unit equal to one sextillion bytes or 1,000 exabytes, representing a vast amount of data far beyond current supercomputing capacities.

2-cube

3-cube

4-cube

5-cube

6-cube

7-cube

8-cube

9-cube

10-cube

591
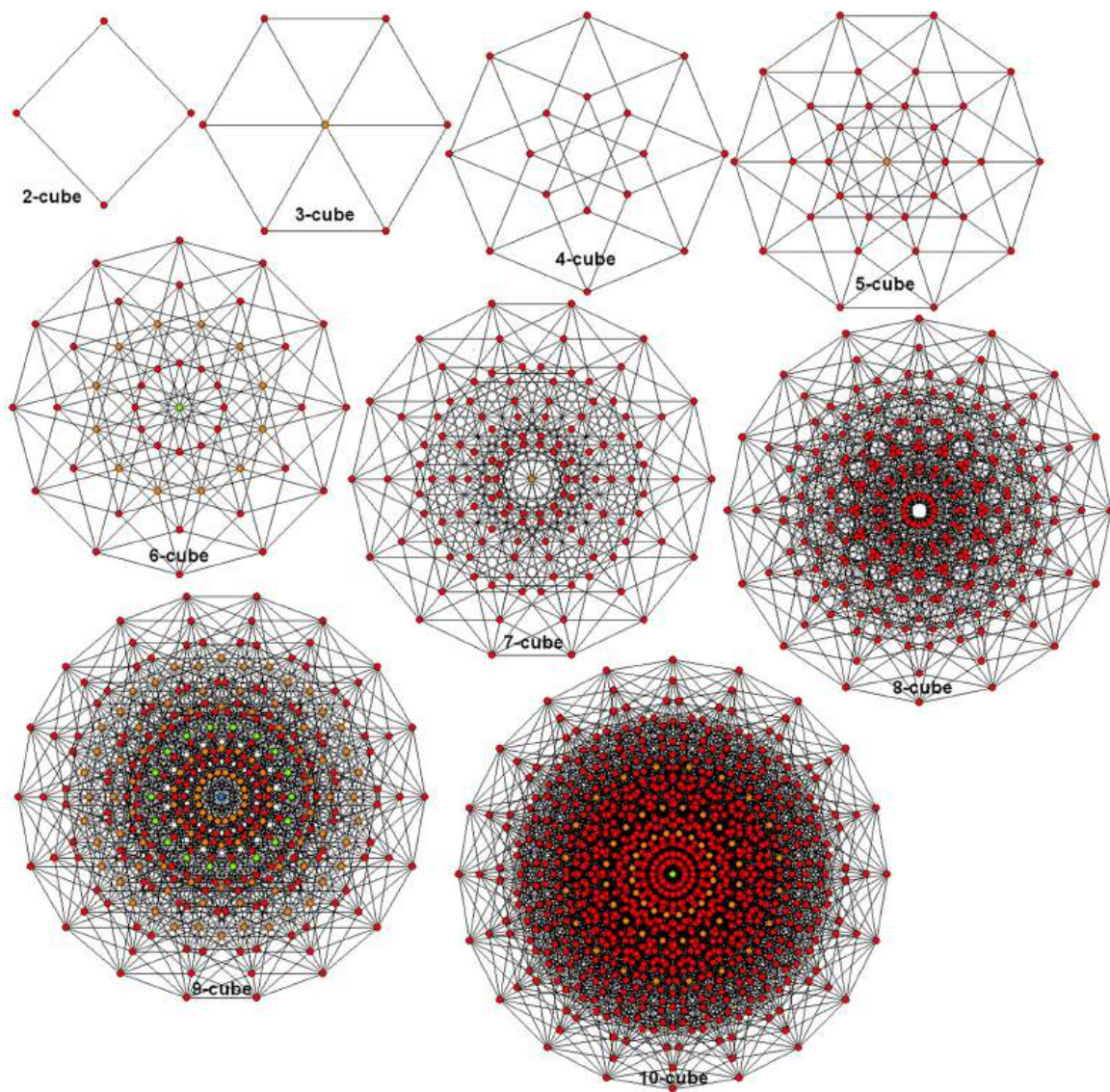
The Worlds' Fastest Computing

- **Automatic Parallelization:** The process where a compiler transforms sequential code into parallel code, enabling concurrent execution on multiple processors without manual intervention.
- **Bandwidth:** The amount of data that can be transmitted over a communication channel in a given time period, crucial for determining the performance and speed of data transfer in computer systems.
- **Benchmark:** A set of tests or tasks used to measure the performance and efficiency of computer hardware or software, providing a standard for comparison among different systems.
- **Cache Line:** A unit of data transfer between cache and memory, usually consisting of a sequence of bytes (64 or 128 typically).
- **CAE (Computer-Aided Engineering):** The use of computer software to assist in engineering tasks, including design, analysis, and manufacturing planning.
- **Capability Computing:** Utilizing powerful supercomputers to solve large and demanding problems, focusing on reducing time-to-solution as the primary performance metric.
- **Capacity Computing:** Involves using smaller, cost-effective high-performance systems to run parallel problems with moderate computational demands.
- **Circuit Speed:** The time required for a signal to traverse through a circuit, influencing the overall performance of a processor.
- **Clock Rate (Clock Speed):** The frequency of a CPU's operational cycles per second, measured in gigahertz (GHz), which, combined with instructions per cycle (IPC), determines the CPU's execution rate.
- **CMOS (Complementary Metal-Oxide-Semiconductor):** A technology used for manufacturing processors and memories, known for its cost-effectiveness and integration capabilities.
- **Distributed Computing:** A computing model where components located on networked computers communicate and coordinate to achieve a common goal.

- **Exabyte:** Equal to one quintillion bytes, a massive unit of data storage.
- **Exaflop:** A unit of computing speed equal to one quintillion (10^{18}) floating-point operations per second, representing extremely high computational capability.
- **Exascale Computing:** Pertains to systems that can perform at least one exaflop, or a billion billion calculations per second, which is a thousand times faster than petascale computers.
- **Finite Element Analysis (FEM):** A numerical technique for finding approximate solutions to boundary value problems for partial differential equations, often used in structural analysis, heat transfer, and other complex simulations.
- **FPGA (Field-Programmable Gate Array):** A hardware circuit that a user can program to carry out one or more logical operations, known for their versatility and performance in specific applications.
- **GPU (Graphics Processing Unit):** A specialized processor designed for rendering graphics but also used for various other computing tasks due to its parallel processing capabilities.
- **Grid Computing:** A form of distributed computing that involves coordinating and sharing computing resources across various domains to work toward a common objective.

- **High Performance Computing (HPC):** Computing at a high performance level, utilizing supercomputers and parallel processing techniques for solving complex computational problems.
- **High Throughput Computing (HTC):** Refers to the use of many computing resources over long periods of time to accomplish a computational task. It emphasizes the high turnover of computationally intensive tasks, rather than their execution speed.
- **Interconnect (HPC Interconnect):** A high-speed network link connecting nodes in a supercomputer, enabling rapid data communication and effective parallel computing.
- **Message Passing Interface (MPI):** A communication protocol used in parallel computing to allow processes to communicate with each other in a coordinated manner, often used in HPC environments.

- **Node:** Refers to an individual computer or server within a larger clustered system, each containing its own local memory and computational resources.
- **Parallel Computing (Parallelism):** Simultaneously using multiple compute resources to solve a computational problem, allowing for faster processing and problem-solving.
- **Parallel Filesystem:** A type of filesystem that allows for simultaneous access from multiple nodes, designed for high performance and concurrent operations.
- **Petabyte:** A unit of data storage equal to one quadrillion bytes, illustrating large data storage capacities.
- **Pipeline:** A sequence of data processing elements where the output of one element is the input of the next, commonly used in HPC to structure and coordinate complex tasks.
- **Portals or Gateways:** In the context of computing, a portal refers to a major starting point for users, providing access to various resources or services. Examples include search engine homepages or specific research databases.
- **Processors:** The primary computing component of a system, responsible for executing instructions and processing data. Modern systems can have multi-core processors, with each core capable of processing tasks independently.
- **RDMA (Remote Direct Memory Access):** A technology that allows data to be transferred directly between two computers' memory without involving either computer's operating system or CPU, enhancing data transfer speed.
- **Scaling Out:** Expanding a system's capabilities by adding more nodes or units, increasing the overall resources without necessarily improving the power of individual units.
- **Scaling Up:** Enhancing a system's capabilities by upgrading the power and capacity of existing units, without necessarily adding more units.
- **Thumb Drive (Flash Drive):** A portable data storage device using flash memory, small in size, and can be plugged into a computer's USB port.
- **Weather/Climate Modeling:** Utilizing computer simulations to predict weather and climate changes based on a myriad of environmental variables.

- **Workload:** Refers to the set of tasks assigned to the system's resources or the amount of work a system can handle.

The mother of Philip Emeagwali (Iyanma Agatha Emeagwali), Philip Emeagwali (Chukwurah), and the son of Philip Emeagwali (Ijeoma), Monkton, Maryland, October 30, 2006

My mother (Iyanma Agatha Emeagwali) and mother-in-law (Johnnie Doris Brown), Baltimore, Maryland, on the occasion of their grandson's, Ijeoma Emeagwali, graduation from Gilman School, Baltimore, Maryland and departure to MIT, Cambridge, MA, June 8, 2008

My wife, Dale, and me, October 28, 2005, Monkton, Maryland, USA.

Philip Emeagwali, Baltimore, Maryland, circa late December 1982.

Agatha, Dale, and Philip Emeagwali, 3610 West Forest Park Avenue, Baltimore, Maryland (mid-August 1984).

Agatha Emeagwali, Ma Mamie Baird, Johnnie Doris Brown, and Dale Emeagwali, 3610 West Forest Park Avenue, Baltimore, Maryland, mid-August 1984.

Ijeoma and Dale Emeagwali, Baltimore, Maryland, December 25, 2000.

My son, Ijeoma, Monkton, Maryland, October 29, 2005
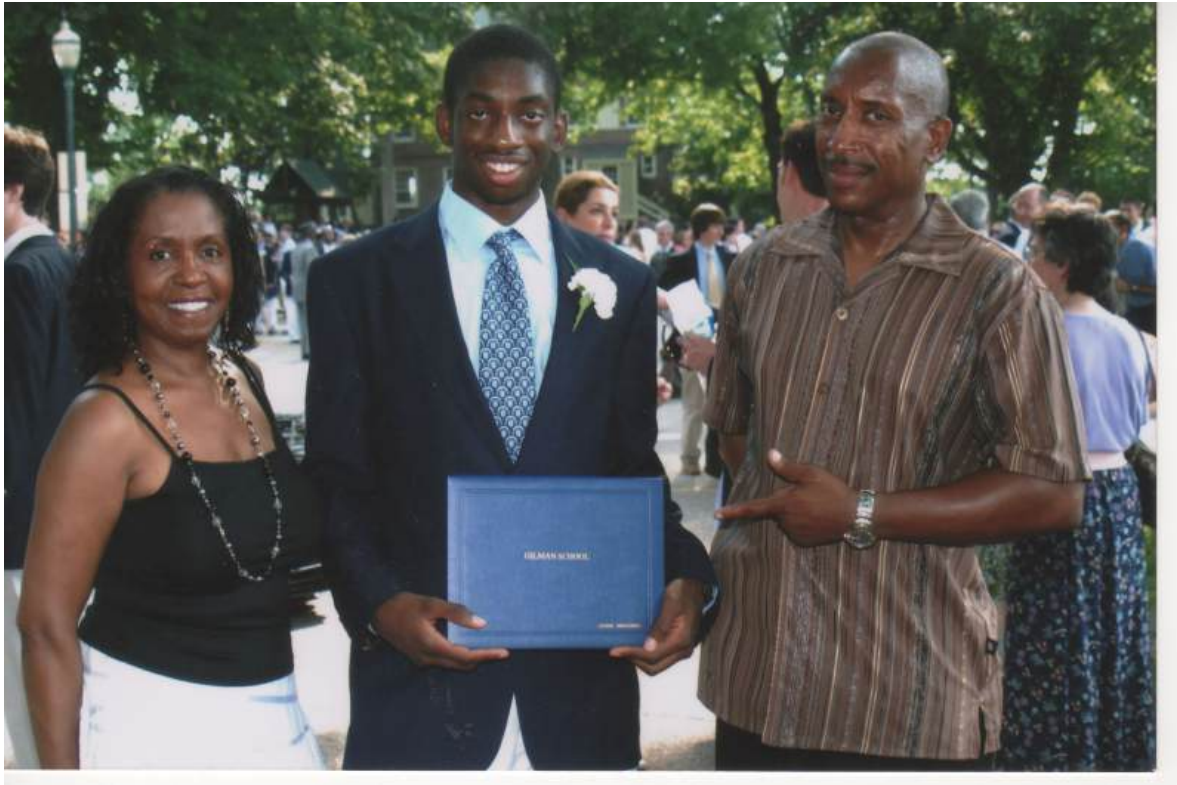
Annette Brown, Ijeoma Emeagwali, and Daryl Brown, June 8, 2008.

CONTACTING PHILIP EMEAGWALI

https://facebook.com/emeagwali

https://twitter.com/emeagwali

https://instagram.com/philipemeagwali

https://flickr.com/philipemeagwali

https://emeagwali.tumblr.com

https://linkedin.com/in/emeagwali

The purpose of this preview is to allow the author identify problems and opportunities for improvement. Please send comments to:

info@**emeagwali.com**

https://**emeagwali.com**

202-203-8724

Philip Emeagwali is pronounced as

FI-lip eh-MAY-ah-gwah-lee

BOOKING PHILIP EMEAGWALI

To inquire about booking Philip Emeagwali for a speaking engagement, please contact us at: info@**emeagwali.com**

https://**emeagwali.com**

202-203-8724

Philip Emeagwali delivering a lecture at the University of Alberta, Canada, September 23, 2006.

AFTERWORD: UNLEASHING THE POWER OF A.I. SUPERCOMPUTERS

As I reflect upon the journey recounted in this memoir, I am filled with a profound sense of awe and gratitude. The path to the invention of the supercomputer was one paved with obstacles, perseverance, and an unwavering belief in the transformative potential of technology. Today, as I sit here and pen these words, I am humbled by the impact that my discovery has had on A.I. computing and the realms beyond.

On that historic day, July 4, 1989, I announced my groundbreaking discovery—the unexpected world's fastest computing across the 65,536 slowest processors in the world. In that moment, the world changed forever. Parallel processing revolutionized computing, opening doors to unprecedented computational power and transforming our capabilities in ways unimaginable.

At its core, parallel processing is the technique of dividing complex computational tasks into smaller, more manageable parts, and executing them simultaneously on multiple processors. It is a symphony of synchronized calculations, a dance of computational harmony that unlocks immense speed and efficiency. By harnessing the power of parallelism, we can tackle complex problems at an astonishing pace, transcending the limitations of sequential processing.

The impact of parallel processing extends far beyond raw computational power. It is the driving force behind the remarkable advancements we witness in artificial intelligence (A.I.) today. Parallel processing provides the computational backbone upon which A.I. algorithms can thrive, enabling machines to learn, reason, and make intelligent decisions. The marriage of massively parallel supercomputing and A.I.has reshaped the boundaries of human knowledge, propelling us into an era of unparalleled technological advancement.

Parallel processing empowers A.I. systems by unleashing the potential for massive data processing, complex simulations, and deep learning. With the ability to execute numerous calculations simultaneously, these systems can process vast amounts of data in real-time, extract patterns, and make accurate predictions. From natural language processing to computer vision, massively parallel supercomputing is the bedrock upon which intelligent systems are built.

Imagine the vast possibilities that artificial intelligence supercomputing offers. It allows A.I. systems to understand human language, engage in meaningful conversations, and assist in various tasks, revolutionizing industries and transforming how we interact with technology. Parallel processing fuels advancements in robotics, autonomous vehicles, and medical diagnosis, among many other fields, propelling us towards a future

where intelligent machines augment our capabilities and make the world a better place.

My invention of parallel processing was born out of a desire to push the boundaries of what was possible, to challenge the status quo, and to unlock the full potential of computing. It is a testament to the power of curiosity, perseverance, and the unwavering belief in one's abilities. However, I am also acutely aware that my contributions were not made in isolation. They were built upon the collective efforts of countless researchers, engineers, and innovators who have tirelessly pushed the boundaries of knowledge.

As I conclude this afterword, I invite you to envision a world where parallel processing and A.I. join forces to solve critical challenges and foster a more inclusive and sustainable future. It is a world where machines become our allies, working alongside us to solve complex problems, improve our lives, and push the boundaries of human knowledge.

The journey continues, and the possibilities are boundless. Together, let us embark on this path of discovery, armed with the power of artificial intelligence supercomputers, driven by a relentless pursuit of knowledge, and guided by the desire to leave a lasting impact on our world.

ACKNOWLEDGEMENTS

 I am deeply grateful to all those who have supported me throughout my journey, making this memoir possible. Their unwavering belief in my potential, their guidance, and their love have been instrumental in shaping the person I am today.

 First and foremost, I express my heartfelt appreciation to my father, Nnaemeka James Emeagwali. You played an exceptional role in my life by imparting your knowledge and wisdom in mathematics during my early childhood in the Nigerian towns of Sapele, Uromi, and Agbor. Your dedication to my education and your patient tutoring laid the foundation for my success in discovering the world's fastest computing. I am forever indebted to you for your unwavering support and belief in my abilities.
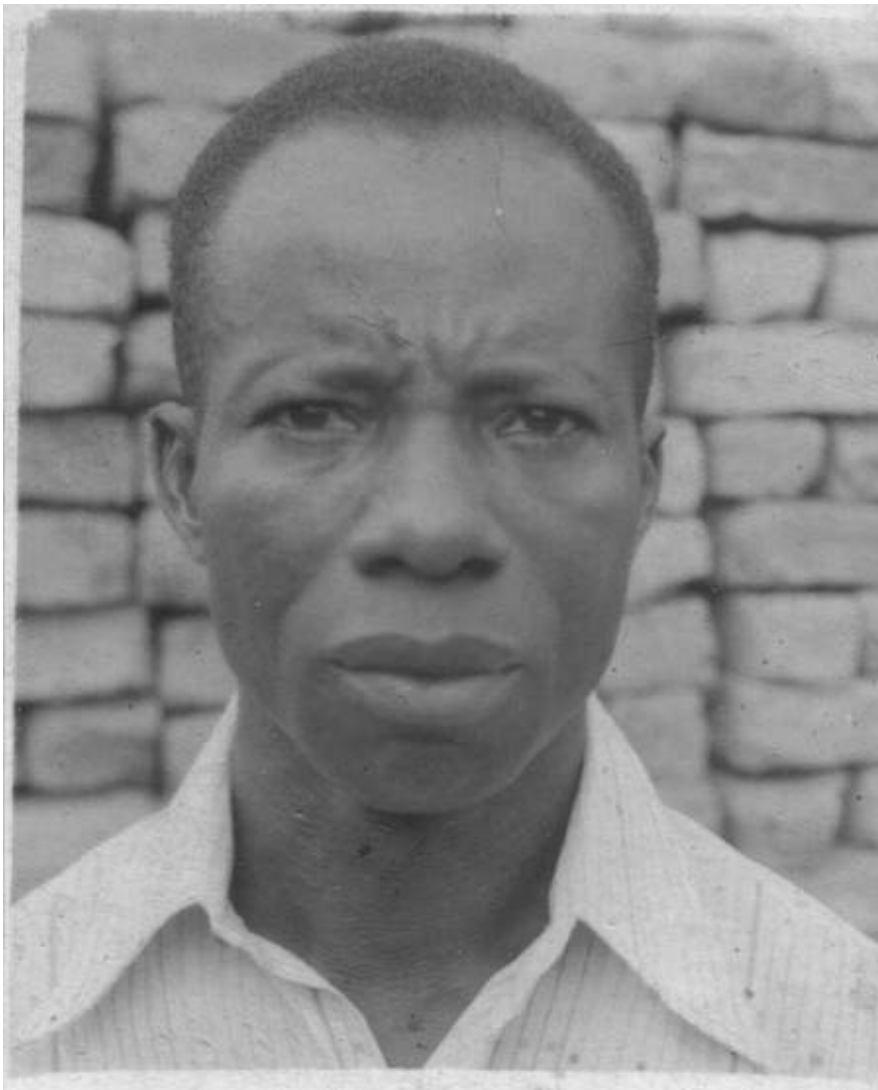
611

To my beloved wife, Dale, I am forever grateful for your constant support and unwavering belief in me. Since we first met in 1978 in Baltimore, Maryland, you have been my pillar of strength and my biggest advocate. Your encouragement, love, and understanding have been the driving force behind my accomplishments. Thank you for standing by my side through the highs and lows, and for being my rock throughout this incredible journey.

I would also like to extend my gratitude to my family and friends who have provided me with continuous encouragement, support, and inspiration. Your belief in me, your words of wisdom, and your unwavering encouragement have been invaluable throughout the years. I am truly fortunate to have such an amazing support system in my life.

Lastly, I thank all the readers of this memoir. Your interest in my story and your willingness to embark on this journey with me is truly humbling. It is my hope that my experiences and contributions can inspire others to pursue their passions, overcome obstacles, and make a positive impact in their respective fields.

To all those mentioned above, and to countless others who have touched my life in significant ways, thank you from the bottom of my heart. Your support has been the driving force behind my accomplishments, and I am forever grateful.

My wife, Dale, Baltimore, Maryland, June 8, 2005.

Philip Emeagwali, Ma Mamie Baird, Agatha Emeagwali, Pa Charles Baird, and Dale Emeagwali, 3610 West Forest Park Avenue, Baltimore, Maryland, mid-August 1984.

A FAREWELL TO MY MOTHER-IN-LAW

It is with deep gratitude and a heavy heart that I stand before you today to share a few words about my mother-in-law, Johnnie Doris (Baird) Brown, who passed away peacefully on Tuesday, May 7th, 2024, at the age of 98. As she was affectionately known, Doris was not merely a family member but a guiding light, a mentor, and a confidante to many. Her passing leaves an immense void in our lives, but we must celebrate her extraordinary life and the indelible mark she left on all who knew her.

Photo: Johnnie Doris Brown

Born on October 15th, 1925, in Ashland, Mississippi, Doris was a woman of remarkable strength and resilience. In 1942, as part of the Great Migration, she embarked on a journey to Baltimore, Maryland, in search of a brighter future. It was there that she met her beloved husband, Leon Robert Brown, a decorated World War II veteran. Their union, on October 16th, 1948, was a testament to their enduring love and commitment.

Doris's life was a tapestry woven with determination, compassion, and an unwavering dedication to her family. She was a devoted mother to three children, a doting grandmother to five, and a cherished great-grandmother to ten. Her home was a haven of warmth and love, where laughter and lively conversations filled the air.

Photo: Johnnie Doris Brown and her husband Leon Robert Brown

I vividly recall the first time I met Doris in the summer of 1978. It was a scorching July day, and I arrived at her home in Lochearn, Baltimore, dressed in my tennis whites, ostensibly on my way to the courts. However, I intended to meet her daughter, Dale, my future wife. Doris and Leon welcomed me with open arms, their backyard abuzz with the enticing aromas of a cookout.

As Leon expertly manned the grill, Doris and I engaged in a delightful conversation. I was immediately struck by her poise, intelligence, and warmth. "Wow," I thought, "Dale inherited her beauty and charm from her mother."

Throughout the years, Doris became an integral part of my life, offering unwavering support and sage advice. She and Leon created a nurturing environment where intellectual curiosity was encouraged. Their dinner table was a forum for lively discussions on a wide range of topics, from science and technology to current events.

This atmosphere of intellectual curiosity undoubtedly played a role in shaping the scientific pursuits of Dale and me. I spent countless hours in

their home, immersed in my work, developing the equations and algorithms that would lay the foundation for my contributions to supercomputing. It was in their home that I, in part, discovered the power of parallel processing, a breakthrough that revolutionized computing.

Doris's passion for knowledge extended to her career. In 1958, she returned to school to become a teacher, a profession she embraced with unwavering dedication for over three decades. Her love for learning was contagious, inspiring countless students to reach their full potential.

One of Doris's most endearing qualities was her deep connection to her roots. She organized a heartwarming welcome reception for my mother, Agatha Emeagwali, when she first arrived in the United States from Nigeria. The gathering was a beautiful blend of Nigerian and American cultures, a testament to Doris's open-mindedness and appreciation for diversity.

Similarly, when my four younger siblings arrived in the United States on Thanksgiving Day in 1985, Doris and Leon opened their home to them, treating them to a traditional Thanksgiving feast. It was a gesture of kindness and generosity that my family will never forget.

Doris's legacy is not merely one of personal achievement but of the countless lives she touched and enriched. Her love for family, her passion for learning, and her unwavering support for those around her is an inspiration to us all.

In the words of the poet Maya Angelou, "People will forget what you said, people will forget what you did, but people will never forget how you made them feel." Doris Brown made everyone she encountered feel loved, valued, and appreciated.

As we bid farewell to this remarkable woman, let us remember the words of the Nigerian novelist Chinua Achebe: "When we gather together in the moonlit village ground it is not because of the moon. Every man can see it in his compound. We come together because it is good for kinsmen to do so."

Today, we gather to mourn the loss of Doris Brown and to celebrate the extraordinary life she lived. May her memory forever be a guiding light, illuminating our paths and inspiring us to be better versions of ourselves.

Edition: 090324

Iyanma Agatha Emeagwali, Philip Emeagwali, and Johnnie Doris Brown, 3610 West Forest Park Avenue, Baltimore, Maryland, mid-August 1984.
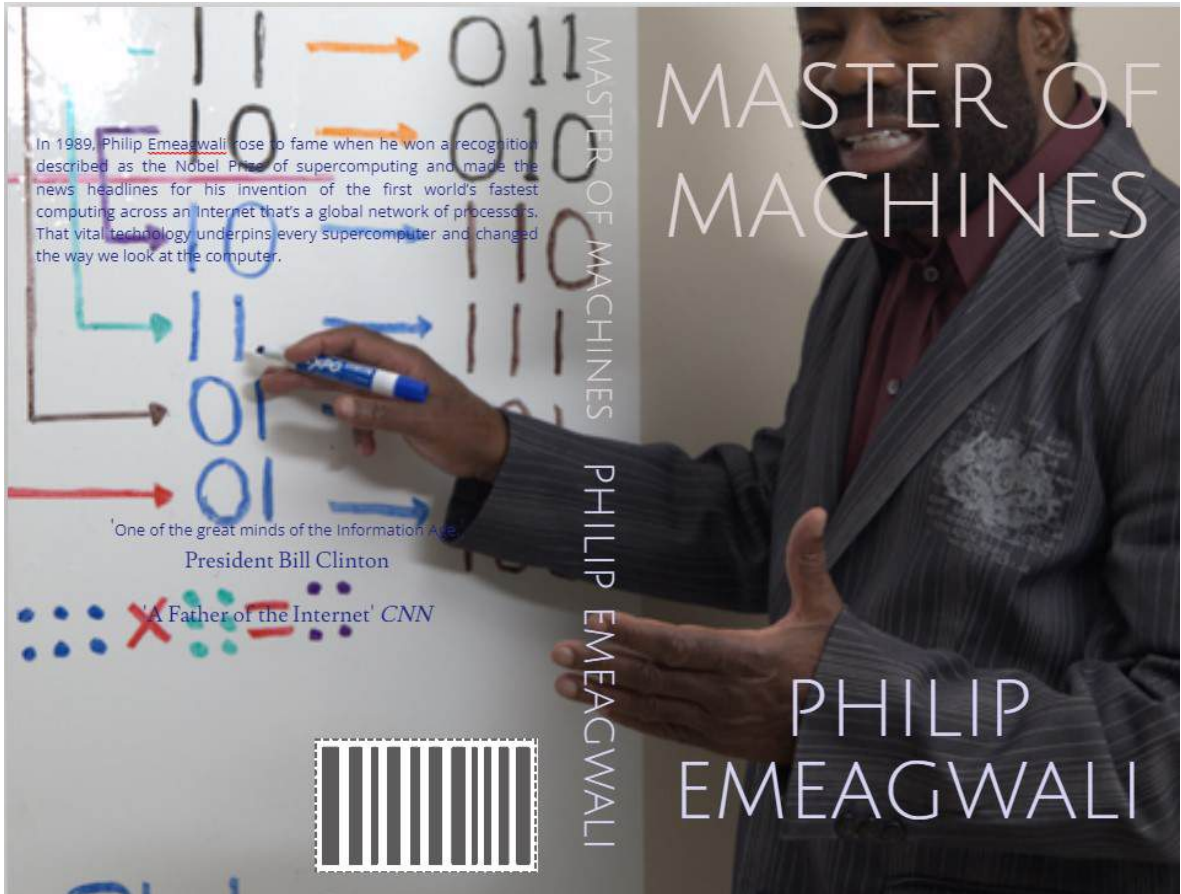
MASTER OF MACHINES

MASTER OF MACHINES

PHILIP EMEAGWALI

MASTER OF MACHINES

PHILIP EMEAGWALI

In 1989, Philip Emeagwali rose to fame when he won a recognition described as the Nobel Prize of supercomputing and made the news headlines for his invention of the first world's fastest computing across an Internet that's a global network of processors. That vital technology underpins every supercomputer and changed the way we look at the computer.

'One of the great minds of the Information Age'
President Bill Clinton

'A Father of the Internet' *CNN*

Table of Contents