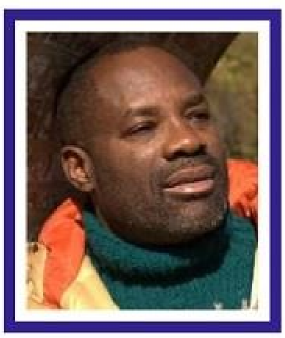
48 Father of Large-Scale Algebra—Part 1 of 10 [A Black Mathematician and His Contributions to Algebra]



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48.1 Opening the Door to Large-Scale Algebra

2300

I made contributions
to large-scale algebra
and I discovered
to how to solve the toughest problems
in modern algebra
and how to use my discovery
to **recover** previously **unrecoverable**
crude oil and natural gas
and to **foresee** previously **unforeseeable**
climate change.

48.1.1 Contributions to Large-Scale Algebra

I mathematically invented
how to solve
the most extreme-scale problems
in modern algebra

and how to solve them
across my new internet
that is a new global network of
64 binary thousand
tightly-coupled processors.
My mathematical invention
of parallel processing
opened the door
to a new world in modern algebra
where the largest system of equations
are parallel processed
and solved
across **10.65 million**
tightly-coupled processors.
Parallel processing in large-scale algebra
is how **10.65 million** days,
or 30,000 years, of **time-to-solution**
are compressed to just one day
of **time-to-solution a**cross
a modern supercomputer
that is a network of

10.65 million
tightly-coupled processors
that are identical.

48.1.2 Crossing the Frontier of Supercomputing

In 1989, it made the news headlines
that I invented
how to harness
the total computing power
of the slowest 65,536
processors in the world,
or harness the power of
as many slow computers,
to solve the toughest problems
arising in algebra.
I invented
how to use those computers
to solve large-scale algebraic problems
arising in computational mathematics

and arising in computational physics
and how to use them
to cross the farthest frontier
in fastest computing,
or supercomputing.
That frontier of modern algebra
was to compute at speeds
in floating-point arithmetical operations
that were previously unimagined,
or to discover
that the **impossible**-to-solve is,
in fact, **possible**-to-solve.
That invention
of the technology called the
massively parallel processing
supercomputer
is used to conquer today's grand
challenges, such as
solving the toughest problems
arising in calculus
that gives rise to the toughest problems

arising in algebra.
An example of a most vexing
grand challenge problem
is to **foresee** previously **unforeseeable**
global warming.
It is one of the toughest problems
arising in calculus
that gives rise to
one of the toughest,
or the most computation-intensive,
problems
arising in algebra.
Another example
of a grand challenge problem
is to **recover** previously **unrecoverable**
crude oil and natural gas.
It is also one of the toughest problems
arising in calculus
that gives rise to
one of the toughest,
or the most computation-intensive,

2305

problems
arising in algebra.
I made that invention
of how to solve the toughest problems
arising in computational mathematics
by sending and receiving
65,536 computer codes
and sending and receiving
the data for each computer code
and I invented how to do so
across a new internet,
or **across** a new ensemble of processors
that communicates and computes
together
as one seamless, cohesive
supercomputer.
I made that invention
by sending and receiving information
and by doing so
across a new internet
that I visualized

as my new **hyperball** supercomputer
and as my new global network of
1,048,576 regular and short
email wires
that are equal distances **apart**.

48.1.3 Crossing the Frontier of Calculus

My contributions to modern calculus
and to large-scale algebra
and to fastest arithmetical computations
were the cover story
of the May 1990 issue
of *SIAM News*.
The *SIAM News*
is the most widely-read news journal
amongst computational mathematicians.
The *SIAM News*
is the most-respected publication
of the Society of Industrial

and Applied Mathematics
and that society is the premier society
for computational mathematicians.
Often, the cover stories
of the *SIAM News*
are mathematical profiles
of newsworthy modern mathematicians
and their newsworthy contributions
to the existing body of
mathematical knowledge.

48.1.4 Opening Doors to Uncharted Calculus

The reason my experimental discovery
in supercomputing
was also the cover story
of the *SIAM News*
was that it opened doors
into unchartered territory
in advanced calculus,

2308

and that it opened doors
into uncharted territory
in large-scale algebra,
and that it opened doors
into uncharted territory
into fastest arithmetical computations.
Put differently, **new** calculus
led me to **newer** algebra
and led me to **newest** arithmetic
that were at the granite core
of my experimental discovery
that opened doors
into uncharted territory
of the massively parallel supercomputer
that is the precursor
of the modern supercomputer of today
that will become
the computer of tomorrow.

2309

48.2 How I Solved the Toughest Problem Arising in Algebra

48.2.1 Translating Physics Across an Internet

The reason my invention
of the modern supercomputer
that computes in parallel
by processing many things (or processes)
at once
was multi-disciplinary
was that I encoded a set of laws
of physics
and that I encoded those laws
into calculus
and that I **translated**
that calculus
into algebra
and that I further **translated**
that algebra
into a set of floating-point arithmetical

operations 2310
and that I further **translated**
those arithmetical operations
into computer codes
and that I, finally,
emailed my algorithms
or instructions
to each of my 64 binary thousand
processors
that outlined my new internet.

48.2.2 Same Problem in Every Processor

Throughout the universe,
the laws of physics
are the same **everywhere**
in the universe.
Throughout the domain
of my initial-boundary value problem,

the system of 2311
partial differential equations
of calculus
are the same
everywhere in the domain.
My system of
partial differential equations
are coupled
everywhere in the domain,
are non-linear
everywhere in the domain,
are time-dependent
everywhere in the domain,
and are hyperbolic
everywhere in the domain.
When the system of
partial differential equations
are the same
everywhere in the domain,
the system of equations
of algebra

that approximated that system
of partial differential equations
of calculus
are diagonal **everywhere**
or are tri-diagonal **everywhere**
or are sparse **everywhere**
and are identically structured
everywhere in the domain.
There are the same
for each subset of algebraic equations.
Because of that sameness
in the physics, calculus, and algebra,
my set of floating-point
arithmetical operations
also had sameness
in every processor
that executed them.
I took advantage of that sameness
to **execute** my floating-point operations
and execute them in parallel.
I **executed** those operations

across my new internet. 2313
I invented that new internet
as a new global network of
65,536
tightly-coupled processors,
or as a new global network of
64 binary thousand computers.
I recorded the previously unrecorded
speed increase of a factor of
65,536
and recorded it because
I **executed** my
65,536 computer codes
and I executed them
with a one-to-one correspondence
between each code
and each processor.
I executed them in parallel
and **parallel computed**
because they are the same

for each processor,
or computer.

48.2.3 Compressing 180 Years to One Day

Because of that sameness everywhere, I
could synchronize
my email communications
that I sent to sixteen-bit long
email addresses.
And that I sent
across my sixteen times
two-raised-to-power sixteen
bi-directional email wires
that I visualized as short wires
printed onto circuit boards,
or as long wires
comprised of fiber optic cables.
I computed in parallel,
or simultaneously,

and did so at two-raised-to-power sixteen, 2315
or 65,536, tightly-coupled processors.
That was how I theoretically
and experimentally **invented**
how to compress 65,536 days,
or 180 years,
of **time-to-solution**
on one processor
and compress that **time-to-solution**
to only one day of **time-to-solution**
across a new internet.
That one day was across my new internet
that I invented
as a new global network of
65,536
tightly-coupled processors
that I named
a HyperBall Supercomputer.

48.2.4 Largest Equations Solved Across an Internet

2316

Back in 1989,
it made the news headlines
that an African Supercomputer Wizard
in the United States
had invented
how to solve
a world record system of
24 million equations
of algebra
and invented
how to solve them **across**
a new internet
that he visualized
as his new global network of
65,536
tightly-coupled processors.
I—**Philip Emeagwali**—
was that African Supercomputer Wizard
that was in the news

back in 1989.
Those system of 24 million equations
that I solved
made the news headlines because
it was the world record
in the world of large-scale
algebraic computations
of 1989.
One secret to my success
in experimentally discovering
how and why parallel processing
makes computers **faster**
and makes supercomputers
fastest, namely,
the Philip Emeagwali formula
that then United States President
Bill Clinton described
in his White House speech
of August 26, 2000.
was how I uniquely visualized

each of my 65,536 2318
tightly-coupled processors.
I visualized each processor
as an **atom.**
I visualized each atom
as equal distances **apart**
and on the surface of a sphere.
I visualized the sphere
in an imaginary sixteen dimensional
universe.
I visualized two-raised-to-power sixteen,
or 65,536, atoms
as together comprising a molecule.
That molecule was my metaphor
for my new internet
that I invented
as a new global network of
65,536
tightly-coupled processors.
Or as a new global network of
as many computers.

Atoms
form the basic building blocks
of a molecule.
Processors
form the basic building blocks
of my **new internet**
that I visualized
in the sixteenth dimension.
Computers
form the basic building blocks
of the **Internet**
that you visualized
in the third dimension.
I visualized my new internet
in the sixteenth dimension.
I visualized my new internet
as two-raised-to-power sixteen
plentiful, powerful, and inexpensive
already-available processors
that are **married together**
by sixteen times

2319

two-raised-to-power sixteen
bi-directional regular, short,
and equidistant email wires
and married together
as one cohesive whole unit
that is not a computer *per se*
but that is a new internet *de facto*.

48.3 Solving the Toughest Problem in Algebra

48.3.1 My Contributions to Algebra

My contributions to algebra
was my invention
of how to solve
the largest system of equations
of algebra
that **arose** from calculus
that **arose** from the petroleum industry's

perennial quest
to **recover** otherwise **unrecoverable**
crude oil and natural gas.
The university calculus teacher
—whether in Nigeria
or in the United States—
does not have the mathematical maturity
and the supercomputer knowledge
that is needed to understand
how a system of coupled, non-linear,
time-dependent, and state-of-the-art
partial differential equations
that is the toughest problem in calculus
that must be used to discover
otherwise elusive
crude oil and natural gas
and recover
otherwise **unrecoverable**
crude oil and natural gas.
The high school algebra teacher
—whether in Kenya

2321

or in Russia—
cannot explain
why the largest system of equations
of algebra
must be solved
as a **precondition** to recovering
the most crude oil and natural gas.
In 1989, it made the news headlines
that I—**Philip Emeagwali**— invented
how to solve
the largest system of equations
of algebra
and invented
how to solve them
across a new internet.
I invented that new internet
as my global network of
equidistant and **uniformly-connected**
processors.
I invented that new internet
as my global network of

as many identical computers
that were equal distances **apart**.

48.3.2 Early Childhood Algebra

My personal journey
to the frontier of large-scale algebra
began with my small-scale
algebra teacher.
It began at Saint George's
Grammar School,
Obinomba, Midwest Region, Nigeria.
In January 1966
and at age eleven,
I enrolled in **Saint George's**
Grammar School, Obinomba.
At **Saint George's**,
I had the misconception
that algebra was **fully known**
and that algebra

had always been **fully known**
and that algebra
had been **fully known**
since time immemorial.
Like any eleven-year-old,
I assumed that
all that can ever be known
about arithmetic or algebra
has been known.

48.3.3 Contributions to Algebra

Fast forward two decades,
and from Nigeria to the United States,
I proved myself wrong
and I did so
by pushing the frontiers
of the most computation-intensive
arithmetic
to execute the fastest floating-point

arithmetical operations
and by pushing the frontiers
of algebra
by solving
the largest system of equations
of algebra.
When a mathematician
pushes the frontiers of mathematics
and did so by making
a notable contribution
to mathematical knowledge
that contribution
makes the news headlines
amongst research mathematicians.
My contributions to mathematics
made the news headlines
in 1989.
My contributions to mathematics
was cover stories
of the top news journals
that were written by

and for research mathematicians. 2326
I mathematically invented
how to solve the largest scaled problem
in algebra.
In decade-long
laboratory experiments
I invented
how to solve the toughest problems
arising in algebra
and solve them
at the fastest floating-point
arithmetical operations per second.
I invented
how to solve them
across a new internet.
I invented that new internet
as a new global network of
64 binary thousand,
or two-raised-to-power sixteen,
tightly-coupled processors
that I visualized

as a cohesive unit in hyperspace
that are **married together**
by sixteen times
two-raised-to-power sixteen
short, regular, and bi-directional
email wires
each printed onto circuit boards.
I named my invention
a hyperball supercomputer.

48.3.4 From Africa to the Frontier of Algebra

For the past five millennia,
each generation of
research mathematicians
contributed
their mathematical discoveries
and inventions
to their existing body of

mathematical knowledge. 2328
The next generation of research
computational mathematicians
will make our impossible-to-solve
possible-to-solve.
I believe that
the nine-year-old girl in Nigeria, Africa,
that is learning
how to solve the quadratic equation
of algebra
will someday solve
mathematical problems
that the mathematical community
now believes will be unsolveable
and, perhaps, be executing
large-scale algebra
across a planetary supercomputer
that will be the technological descendant
of our internet.
Or be the technological descendant
of my hyperball supercomputer

that I visualized
as a small copy of the Internet.
That **as-yet-unknown**
nine-year-old Nigerian girl
is, perhaps, in a poorly-equipped school
in a small village
outside my ancestral hometown
of Onitsha
in the heart of Igbo Land, Nigeria.
In January 1966,
I enrolled at **Saint George's**
Grammar School,
an all-boys Catholic school
in the outskirt of my ancestral Igbo Land.
I enrolled in the seventh grade,
called "class one."
A casual perusal of my school pictures
that I posted online
—at **emeagwali** dot com—
will reveal that
some of my class mates

—at Saint George’s Grammar School— 2330
were almost three times my age.
Because I was the youngest
and the smallest boy
in that boarding school photograph,
I was physically challenged
to keep up with the school’s
soccer games
or mandatory daily manual labor.
At **Saint George’s Grammar School**,
all students were boarders.
At 6:00 a.m. in the mornings
and at 6:00 p.m. in the evenings,
each student fetched water
for the dormitory kitchen.
We fetched water
from **River Ethiope**.
We bathed
in **River Ethiope**.
We used the crystal clear **River Ethiope**
as our swimming pool.

And we cut grasses with cutlasses, 2331
and did so one evening a week.
And we danced on Saturday nights
and danced
to the highlife music of
Cardinal Rex Lawson.
At **Saint George’s Grammar School**,
we learned how to solve
the quadratic equation of algebra.
We learned the quadratic equation
from an algebra textbook
that was written by
an English schoolmaster
named C.V. Durell.
Durell’s initials, C.V.,
stood for “Clement Vavasor.”

48.4 Solving the Impossible-to-Solve in Algebra

2332

48.4.1 Father of Large-Scale Algebra

The invention
of parallel processing
increased our knowledge
of what makes the computer
faster
and makes the supercomputer
fastest.
The invention
of the modern supercomputer
makes it possible
to **recover** otherwise **unrecoverable**
crude oil and natural gas.
In the 1980s, to parallel process,
or to solve many sets of
system of equations of
the most large-scale algebra

and to solve them **at once**
and to communicate their answers
via emails
that I sent to and received from
sixteen-bit long addresses
and that I delivered
across one binary million email wires
and to solve
that large-scale algebraic problem
and solve it a**cross**
64 binary thousand
processors,
was ridiculed
as a beautiful theory
that lacked experimental confirmation.
In the 1970s,
harnessing eight processors
was **impossible**
and was codified as impossible
by the infamous **Amdahl's Law**.
That is, the knowledge of

how to harness
the supercomputing potential
of 64 binary thousand
processors
and how to use them
to solve the **toughest problems**
in physics and calculus
was not in any
physics and calculus textbook
and could not be taught
in any university.
The June 14, 1976 issue
of the *Computer World* magazine
carried an article titled:

[quote]
"Research in Parallel Processing
Questioned
as a 'Waste of Time.'"
[unquote]

2334

I began programming
sequential processing supercomputers
at age nineteen.
And I began supercomputing
on Thursday June 20, 1974.
I began supercomputing
at 1800 SW Campus Way,
Corvallis, Oregon, United States.
On Saturday March 23, 1974,
I emigrated from Onitsha (Nigeria)
to Oregon (United States)
and from **Igbo Land**, Nigeria
to Anglophone Land, United States.
A century and a decade earlier
and prior to my emigration,
there were no schools in Igbo Land.
And for that reason,
nobody in mid-19th century Igbo Land
could multiply **two** three-digit numbers.
The marker of Igbo progress

is that I—**Philip Emeagwali**,
a son of the soil of **Igbo Land**—**invented**
how to perform
the fastest multiplications
that arose from algebra, calculus,
and physics
and **invented**
how to perform
those fastest multiplications
across a new internet.
I invented that new internet
as a new global network of
64 binary thousand
tightly-coupled processors
that were equal distances **apart**.

48.4.2 Following in the Footsteps of My Father

The body of scientific knowledge
grows in the manner

the distances covered in a relay race
grows.
The reason our world became a more
knowledgeable place
was that each generation
passed their scientific batons
to the next generation,
transferred their scientific knowledge
to the next generation,
and taught their scientific discoveries
to the next generation.
When my son, Ijeoma,
was born—on June 15, 1990—
I was in the news
in **Silicon Valley**, California.
I was in the news
for experimentally discovering
how and why parallel processing
makes modern computers **faster**
and makes the new supercomputer
the **fastest**.

I was in the news 2338
for my contributions
to the body of technological knowledge
that is the modern supercomputer.
Likewise, Ijeoma,
is following in my footsteps
as a computer scientist in the news
and following it
in **Silicon Valley**, California
where I first made the news.
Like Ijeoma did, I followed the footsteps
of my father,
Nnaemeka James Emeagwali,
to become the second person
in my family
that could solve the quadratic equation
of algebra.
I went farther than my father
by inventing
how to solve the toughest problem
arising in large-scale algebra,

namely, solving a world record
system of 24 million equations
of algebra
and making the news
for breaking that world record
in 1989.
And my father followed in the footsteps
of his uncle, **Peter Emeagwali**,
who was the first person
in the extended Emeagwali family
to learn arithmetic
in the late 19th century.
Uncle **Peter Emeagwali**
lived in Kano, Northern Nigeria
where he had a small fleet of lorries.
The lorries of uncle **Peter Emeagwali**
competed for passengers and goods
with the lorries of
Louis Odumegwu Ojukwu.
Louis was the father of
Chukwuemeka Odumegwu Ojukwu.

Chukwuemeka led Biafrans 2340
during the June 1967
to January 1970
Nigeria-Biafra Civil War.
All schools in war-torn Biafra
were closed for three years.
One in fifteen million Igbos died
in that war.
My hometown of Onitsha (Nigeria)
became the bloodiest battlefield
in Africa.
In the night of about March 30, 1968,
I lost two cousins,
Patrick Okwuosa and John **Okwuosa**
of Egerton Road, Onitsha
that was across the street from
Zik's Institute.
A century before I was born,
none of my Igbo ancestors
that lived in Nigeria
could write their names.

48.5 The First School in Igbo Land

48.5.1 Distant Influences

My biggest influence and role model
was my father.
My father attended
Christ the King College, Onitsha,
in the then British West African colony
of Nigeria.
My father attended
Christ the King College
in the six years between 1942
and 1947.
Christ the King College
was one of the top high schools
in Colonial Africa.
And its academic standards
were the same as those of the top

high schools
in **Dublin, Ireland**.
All of my father's high school teachers
were born in **Ireland**.
Back in 1947, there were no universities
in Nigeria which, in part, explained
why my then 26-year-old father
could not continue his education
within Nigeria.
My father's older brother,
John Emeagwali,
was amongst the first generation
of Igbos
that attended high school.
The first high school in Igbo Land—
Dennis Memorial Grammar School,
Onitsha, Nigeria—
was a five-minute walk from our
ancestral home
at 17 Mba Road, Umudei Village,
Onitsha.

Uncle John Emeagwali
was employed by Nnamdi Azikiwe
to help produce Zik’s newspapers,
such as *The West African Pilot*
in Lagos (Nigeria)
and The Spokesman
in Onitsha (Nigeria)
that employed the noted economist
Pius Okigbo as one of its reporters.
John Emeagwali and Nnamdi Azikiwe
were in the same age grade society
of those born in 1904
in Onitsha (Nigeria).
My great grandfather,
who was born and buried at
17 Mba Road, Umudei Village,
Onitsha, Nigeria,
whose first name was “**Emeagwali**,”
had a brother whose first name
was “**Mba**.”
whom, I believe, was christened as

“**Christopher Mba**” 2344
for whom **Mba Road**, Onitsha,
was named after.
The first Christian mission
in Igbo Land
was found on July 31, 1857
in Inland Town, **Onitsha**.
The first school in Igbo Land
was found in the following year,
on November 15, **1858**.
My great grand uncle **Christopher Mba**
attended that first school
in Igbo Land.
That first school
was only a short walk
from the ancestral home
of **Christopher Mba**
and his brother,
my great grandfather **Emeagwali**.
The first students in that first school
in Igbo Land

were fourteen teenage slaves.
Because the first students
were all slaves,
it created the initial perception
in mid-19th century **Onitsha (Africa)**
that schools were only for **slaves**.
Perhaps, like his contemporaries,
my great grandfather, **Emeagwali**,
refused to enroll in that first school
and did so to keep his social distance
from those fourteen teenage slaves.
As far as I can learn from my inquiries,
my great grandfather,
whose first name was "**Emeagwali**"
did not enroll in that first school
in Igbo Land,
even though that first school
was a ten minute walk
from his backyard.

48.5.2 My First School

I learned the **times table**
of arithmetic at age five.
My quest for the uncharted territory
of the fastest arithmetical computations
was to figure out
how to make the **impossible-to-multiply**
possible-to-multiply,
namely,
figure out how to use
65,536
tightly-coupled, commodity processors
and use them to compress
65,536 days, or 180 years,
of **time-to-solution**
of the most computation-intensive
grand challenge problems
and compress them
to just one day of **time-to-solution**.
That mathematical journey

to the frontier of **fastest times tabling** 2347
began with
my first step of enrolling
in the first grade
and doing so in January 1960
at Saint Patrick's Primary School,
Sapele, in the Western Region
of the British West African colony
of Nigeria
and enrolling in that school
at age five.
At Saint Patrick's Primary School,
I dreaded mathematics
and I was the worst student
in Primary One.
My father, Nnaemeka, demanded that
I study twenty times longer
than my classmates
and I did so by solving
one hundred [100] additional
arithmetical problems

each evening.
My primary school classmates
only solved five problems
each school day.
Studying twenty times longer
than my classmates
was why and how
I became the best student
at later schools that I attended,
such as the Saint Anthony's Primary
School, Uromi, Western Region, Nigeria,
that I attended in 1962 and '63
and the Saint John's Primary School,
Agbor, Mid-West Region, Nigeria
that I attended in 1964 and '65.

48.5.3 The First School in Igbo Land

Igbo Land is my ancestral land.
The oldest school in Igbo Land

was founded 2349
on November 15, 1858.
That oldest school was founded
in my ancestral hometown of **Onitsha**
(Africa).
That school was founded at a time
my country of birth
Nigeria
was not on the map of Africa.
That school was founded at a time
the word "**Nigeria**"
had not been coined.
The oldest school in Igbo Land
was a short walk
from 17 Mba Road, Umudei Village,
Onitsha
that was the ancestral home
of my great grandfather,
whose first name was
"**Emeagwali**."
That school was found

by an Igbo-speaking Sierra Leonean 2350
who came to Igbo Land
from Freetown, **Sierra Leone**,
West Africa.
That Sierra Leonean
was a rescued Igbo slave
and who was renamed **John Taylor**.

48.5.4 The First High School in Igbo Land—Repeat

As I said earlier,
the oldest secondary school
in Igbo Land
is Dennis Memorial Grammar School,
Onitsha,
also called D.M.G.S.
Dennis Memorial Grammar School
was in the **British Protectorate**

2351

of Southern Nigeria.
D.M.G.S. was found in **1925**
and is located a short walk
from the birthplace
of my father and fore fathers.
My uncle, **John Emeagwali**,
was among the first students
of Dennis Memorial Grammar School.
My father and I,
attended Christ the King College,
Onitsha (Nigeria)
that was found in **1933**
and is one of the oldest schools
in Nigeria.
Mba Road, Onitsha,
was named after **Christopher Mba**
(Isaac Mba, fact check with
Augustine Emeagwali),
who is the brother
of my great-grandfather.
Christopher Mba
attended the first primary school

in Onitsha.
Christopher Mba was the first convert to christianity.
Christopher Mba
was baptized five years after
Samuel Ajayi Crowther,
the first African Anglican Bishop,
set up his mission in Onitsha (Africa).
Christopher Mba
was baptized by **Samuel Ajayi Crowther**,
who shortly after was ordained a bishop.

48.6 My Early Years in Algebra

48.6.1 Childhood in Yoruba Land

There are more people living in Nigeria today
than ever lived in Nigeria
before.
Excluding my ancestors

that made it to the Americas
and that made it across
the **Middle Passage**
and that survived
the four hundred years
of **Trans-Atlantic Slave Trade**,
I was one of the first persons
in the **Emeagwali** lineage
to be born outside 17 Mba Road,
Umudei Village, Onitsha, Igbo Land.
I was born on August 23, 1954
in an Igbo-speaking compound
and in a Boy's Quarter
at the intersection of **Ekemeso** Street
and **Oba Adesida** Road,
Akure, Yoruba Land
in the Western Region
of the then British West African colony
of Nigeria.
Back in 1954,
the Union Jack **flew across**

the British Commonwealth,
flew across British West Africa
and **flew across**
the British colony of Nigeria.
Back in 1954,
it was said that
"the sun never sets
on the **British Empire**."
The reason the sun never sets
on the **British Empire**
was because it was daylight
at all hours in some colonies
within the **British Empire**.

48.6.2 Earliest Mathematicians in Onitsha, Nigeria

The algebra textbook used in schools
in the British Commonwealth
was written by the same author,
who was named **C.V. Durell**.

2355

From Nigeria to India
to the United Kingdom
we all learned
the quadratic equation of algebra
and first learned it
from the book written by
C.V. Durell.
But the quadratic equation
has been known for more than
two thousand years.
The quadratic equation was also known
to **Euclid**, a **black African**
who is the father of geometry.
Contrary to popular **distortions**,
Euclid never travelled outside Africa.
Euclid wrote that he lived
in a predominately black
and African city.
There is no primary document
that could lead anyone
to be believe that

Euclid is not a black African. 2356
Euclid
is one of the thousands of
African mathematicians
that lived in Africa
and contributed
to mathematical knowledge.
African mathematicians
made their contributions
two thousand
and three hundred years ago.
Two thousand years ago,
the mathematical knowledge in Africa
was greater than that in Europe.
Africa lost its top ranking
as the continent to learn mathematics
and lost it a thousand years ago.
When my father,
Nnaemeka James Emeagwali,
graduated from Christ the King College,
Onitsha, Nigeria, back in 1947,

and after studying for six years 2357
for the **Senior Cambridge Examinations**
he was one of the few people
in Igbo Land
that understood how to solve
a small system of equations
of algebra.
At Christ the King College,
Onitsha, Nigeria,
my father's teachers were
Irish priests
that were trained in Ireland.
My father's algebra teacher
and my **grandfather-in-algebra**
was an Irish priest named
Michael Flanagan
who left Christ the King College
in 1948 and as its principal
and left to teach in his alma mater,
Blackrock College
that was a top ranked private school

in Dublin, Ireland. 2358
In some ways,
a school like **Blackrock College**
in Dublin, Ireland
might have inspired the founding
of Christ the King College,
Onitsha, Nigeria, British West Africa
that was founded in 1933.
Blackrock College
was the second ranked secondary school
in Ireland
and Christ the King College,
Onitsha, was the Nigerian equivalent
of **Blackrock College**.
Before I enrolled
at **Saint George's Grammar School**,
back in January 1966,
my father, Nnaemeka James Emeagwali,
gave me a head start
by teaching me
how to solve the quadratic equation

of algebra.
My father, Nnaemeka, taught me back in 1964,
how to solve
a system of two equations
of algebra.

48.7 My Contributions to Algebra

48.7.1 An Onitsha Mathematician in Oregon

In 1946, my father, Nnaemeka,
who was my first algebra teacher
had learned how to solve
a system of two equations of algebra.
In 1946,
the frontier of knowledge in algebra
was how to use a supercomputer
to solve
a system of 29 equations

of algebra.
But in faraway United States,
at Aberdeen Proving Ground,
in Aberdeen, Maryland,
that was just 26 miles
outside the birthplace of my future wife,
Dale,
the first generation of
computational mathematicians
were trying to figure out
how to program
the first programmable supercomputer.
They were trying to figure out
how to program a supercomputer
and program it to automatically solve
a system of up to 29 equations
of algebra.
Fast forward, two and half decades,
to June 20, 1974,
I was in 1800 SW Campus Way,
Corvallis, Oregon, United States

where I was programming
a supercomputer
that was ranked
as the world's fastest computer
back in 1966.

48.7.2 My Contributions to Algebra

Fast forward another decade and half
to 1989,
it made the news headlines
that an African supercomputer wizard
in the United States
had invented
how to harness an ensemble
of 64 binary thousand
identical and **equidistant**
processors
that are tightly-coupled,
or as many similar computers,

that are equal distances **apart**
and invented
how to harness those processors
to perform
the world's fastest computations.
I—**Philip Emeagwali**—
was that African supercomputer scientist
that was in the news in 1989.
In decade-long
laboratory experiments,
I invented
how to program
the most massively parallel
supercomputer
ever built.
I invented
how to use those processors
to solve
a then unheard of system of 24 million
equations of algebra
that arose from computational fluid

dynamical calculations, 2363
such as **foreseeing**
otherwise **unforeseeable**
global warming
or **recovering**
otherwise **unrecoverable** crude oil and natural gas.
That invention
opened the door
to a new mathematical world
where we can solve
the most extreme-scale problems
in algebra
and solve them **across**
tightly-coupled processors,
or **across** computers.
Since the fastest computer
does not remain the same,
how to solve
the most computation-intensive problems

across the fastest computers 2364
may not remain the same.
The supercomputer of today
is a **zillion** times faster than
the supercomputers of **yesteryears**.
One reason the modern supercomputer,
of the 1990s and later,
is faster by several orders of magnitude
than the conventional supercomputer,
of the 1980s and earlier,
is that the modern supercomputer
it is built upon the
invention
of parallel processing,
or processing many things (or processes)
at once,
instead of processing
only one thing
at a time.
Parallel processing
was the new frontier

that I crossed in 1989 2365
to conquer
the extreme-scale problems of arithmetic
and algebra.
The reason my **mathematical studies**
and my **laboratory** invention
of 1989
is the subject of school reports
is that it was a pivotal moment
for the modern supercomputer.
My **invention**
of the massively parallel processing
supercomputer
in 1989
heralded the end of the era
of vector processing supercomputer,
and is the starting point
of the modern supercomputer
that will become the computer
of tomorrow.
That **invention**

was the moment
the modern supercomputer
stood apart from the computer.

48.7.3 History of Algebra

The small scale algebra
that you learned in school
was continuously developed
from the era of **Jesus Christ**.
The greatest misconception
amongst Africans
was that algebraic knowledge
was conceived and fully developed
in Europe
and had always been known
to our distant ancestors.
The contemporaries of **Jesus Christ**
could not solve
a small system of equations

of algebra. 2367
Muḥammad ibn Mūsā al-Khwārizmī
of the House of Wisdom
of Baghdad (present day Iraq)
is one of the fathers of algebra.
Al-Khwārizmī
is remembered for his
9th century treatise
that remained the standard algebra
textbook for coming centuries.
Despite his genius,
Muḥammad ibn Mūsā al-Khwārizmī
and his contemporaries
could not solve
a small system of equations
of algebra.
The algebra textbook of C.V. Durell
—that my father and I used
at Christ the King College,
Onitsha, Nigeria
in the early 1940s and early 1970s,

respectively— 2368
had undergone numerous revisions
and updates from the textbooks
that the likes of **Al-Khwārizmī**
wrote
over the preceding millennium.
My mathematical quest
was to discover new large-scale algebra
that was not known to the modern
al-Khwārizmīs,
or the C.V. Durells of today.
In my small-scale algebra class
of 1970
at Christ the King College,
Onitsha, of post Biafran war Nigeria,
my algebra teacher
Sylvester Aniga
focused on the numbers
and on a system of two equations
of algebra.
Fast forward twenty years

after I had left Christ the King College,
Onitsha, Nigeria,
and I was in the United States,
I was at the frontier of knowledge
of the most large-scale algebra,
namely, solving the largest
system of equations of algebra
and solving it
faster and more accurately
than anyone before me did.

48.8 Father of Large-Scale Algebra

48.8.1 Closing: Philip Emeagwali and His Contributions to Algebra

I invented
how to solve
the largest system of equations

of algebra
and how to solve it
across a new internet.
I invented that new internet
as my new global network of
65,536
tightly-coupled processors
that is *de facto*
a new hyperball supercomputer
that I visualized
in sixteen-dimensional hyperspace
and that I visualized
as married together
by sixteen times
two-raised-to-power sixteen
short, regular, and bi-directional
email wires printed onto circuit boards.
To recover crude oil and natural gas
from the oilfields in Nigeria
demands that crude oil and natural gas
be **set in motion**.

Crude oil and natural gas are **set in motion**
by pumping water
into the crude oil and natural gas field
and pumping water
to push the crude oil and natural gas
and push them to nearby crude oil and natural gas production wells.
Because it's impossible
to build a physical model
of an oilfield,
I had to simulate the motions
of crude oil, injected water,
and natural gas inside
and **across** a production oilfield.
My accurate simulation of that motion
demanded that I invent
how to simultaneously solve
a system of 24 million equations
of large-scale algebra

and extreme-scale computational
physics.

48.8.2 My Breakthrough Moment

In 1989, it made the news headlines
that an African Supercomputer Wizard
in the United States
had invented
how to solve a world record
system of 24 million equations
of large-scale algebra
and extreme-scale computational physics
and how to solve them
in parallel,
or by solving
64 binary thousand sets
of systems of equations
of large-scale algebra
and extreme-scale computational physics

and solving them **at once**,
instead of solving only one
system of equations of algebra
at a time.
or by doing 64 binary thousand things
at once,
instead of doing only one thing
at a time.
I—**Philip Emeagwali**—was that
African supercomputer scientist
that was in the news in 1989.
To put my world record
supercomputer calculations
in the context of the 1980s,
a system of 24 million equations
of large-scale algebra
and extreme-scale computational physics
was, **in that decade**,
too memory-intensive
and, **in that decade**,
too computation-intensive

and, for both reasons,
they could not be solved
on the fastest supercomputer
in the world.
That large-scale algebraic problem
begged to be solved **across**
the 65,536
tightly-coupled processors
that **defined** and **outlined**
the most massively parallel processing
supercomputing machinery
that was **ever built**.
I—**Philip Emeagwali**—was the sole
fulltime programmer
of that massively parallel
processing supercomputing machinery.
That machinery is the **pre-cursor**
to the modern supercomputer of today.
In 1989, it made the news headlines
that I invented
how to harness the millions of

processors
of the modern supercomputer
and how to use them to solve
the toughest problems
in large-scale **algebra.**
That invention
was in the June 20, 1990 issue
of *The Wall Street Journal*.
That invention
opened the door to large-scale algebra.
That invention of large-scale algebra
is my contribution **to algebra**.

48.8.2.1 Call to Action

I'm **Philip Emeagwali**.
Let's keep our conversation on algebra
alive at **emeagwali** dot com.

48.8.2.2 Last Sixty Seconds

For last/first 15 seconds
Bows, Smiles

Thank you.
Thank you.
Thank you very much.

I’m **Philip Emeagwali**.