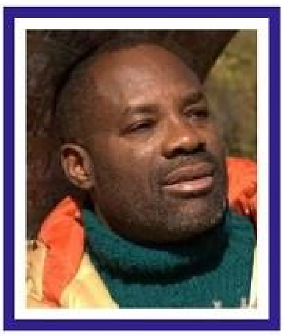
47 Philip Emeagwali's Cosmic Supercomputer



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47.1 My Quest for the Fastest Supercomputer

47.1.1 Introduction

In supercomputing,
the most coveted achievement, bar none,
is to discover how to record
previously unrecorded speeds
in computations.
In the 1970s and ‘80s,
parallel processing
—or doing many things at once,
instead of one thing at a time—
was dismissed as a beautiful theory
that lacked experimental confirmation.
Parallel processing
enables us to obtain a **surer** and **deeper**
understanding
of our universe, and in particular,
enables us to **foresee** otherwise
unforeseeable climatic changes
that enshroud the Earth.
Faster supercomputers

enable us to climb higher 2249
up the ladder of knowledge
and to make the **impossible**-to-compute
possible-to-compute.

Back in 1989,
it made the news headlines
that an "African Supercomputer Wizard"
in the United States
had theoretically discovered
how to solve
a world record system of
24 million equations
of algebra
and experimentally discovered
how to solve them across
an internet
that he visualized
as his global network of
65,536
tightly-coupled processors.

I—Philip **Emeagwali—**
was that African supercomputer scientist
that was in the news
back in 1989.
The modern supercomputer
that computes in parallel,
or by solving
a million mathematical problems
at once
arose from our need
to make the **impossible-to-compute**
possible-to-compute.
I invented the massively
parallel processing supercomputer,
the technology
that makes computers **faster**
and that 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.

I invented
how to solve those computation-intensive problems
and how to solve them
across a small internet
that is a global network of
64 binary thousand
tightly-coupled processors,
or as many tiny computers.

Back in 1974,
I visualized supercomputing **across**
a new global network of computers
that is now called
the **Philip Emeagwali** internet.

47.2 Cosmic Supercomputer on the North Pole

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47.2.1 Philip Emeagwali Cosmic Supercomputer

Back in the mid-1970s,
I needed a name
for the new **Philip Emeagwali** internet.
That new internet
evolved into a global network
of 64 binary thousand
tightly-coupled processors.
That new internet
was a new global network of tiny computers.
The reason I named that new internet
a **HyperBall** supercomputer
was because it was a computer *de facto*.
And I visualized that new
HyperBall supercomputer
as a huge ball
that has the diameter of a soccer field
and has identical processors
and has regular and short fiber optic

email communication wires
that are equidistantly distributed
on the surface of that huge ball.
I visualized that Cosmic Supercomputer
in its own technology park.
I visualized that Cosmic Supercomputer
as making parallel processing
a vision of hope.
I visualized that Cosmic Supercomputer
as the world's fastest, biggest,
and most expensive computer.
I visualized that Cosmic Supercomputer
as being jointly owned by all nations,
or owned by the United Nations,
and owned in the manner that
the Large Collider of CERN
—the European Organization
for Nuclear Research—is owned
by European nations.
I visualized that Cosmic Supercomputer
as staying online for a century.
In the decades of the 1970s, and '80s,
I was the supercomputer programmer

that was the lone wolf
in the wilderness,
that was the uncharted territory
where it was said that
parallel processing across
a cosmic supercomputer
will forever remain a beautiful theory
that will forever lack
experimental confirmation.
And **I visualized** that Cosmic Supercomputer
as the precursor
to the planetary-sized cosmic brain
that I envisioned as emerging
from the internet of the future
and emerging to enshroud the Earth
with digital intelligence.
Every invention is to some extent **partial**
or **false**.
The invention is **false** because
the inventor don't fully understand
what he invented.
And the invention is **partial**, or incomplete,
because it was

and will always remain
an invention-in-progress,
or sometimes an invention without a name.
The users of an invention,
such as the internet,
brings their experiences
and in that sense
the users help the invention evolve
in unforeseen directions.
As an inventor,
I failed a thousand times
but I failed better with each failure.

47.2.2 A Small Copy of the Internet

An ensemble of processors,
or computers,
that compute together
to solve one computation-intensive problem
can have different names.
The ensemble was called a supercomputer
when I invented

how to program 2256
the a new global network of
65,536 tightly-coupled processors
within my new internet
and invented how to parallel program
those commodity-off-the-shelf processors
to compute together
as one cohesive, seamless,
never-before-seen supercomputer
that was the precursor
to the modern supercomputer
and invented how to parallel program
those processors
to compute at the fastest speeds
and invented how to use them
to send and receive emails
synchronously.
But the ensemble is called an internet
when it is used to perform
fewer computations
and to send and receive emails
asynchronously.
Whether you call the ensemble

a new computer or a new internet,
the core story remains constant.
It was the story of an ordinary computer
that only computed in the mid-20th century
that grew and evolved
to an extraordinary, Earth-sized
global network of both computers
and fiber-optic wires
and that is a large copy
of the global network of
64 binary thousand
processors
that I invented
and used to experimentally discover
parallel processing.

47.2.3 How I Invented a Small Copy of the Internet

To invent a computer
is the act of seeing for the first time
a computer
that is faster than any supercomputer

that had been seen before. 2258
To invent a new internet
is the act of seeing for the first time
a new global network of processors,
or a new global network of computers
that had never been seen before.
The inventor is a visionary.
The inventor becomes a futurist
when he imagines and invents products
that we can use in ten decades.
Inventors that pushed the frontiers of
information technology
are tomorrow's thought leaders.
The grand challenge of the 21st century
lies at the crossroads of globalization
and information technology.
The inventor
must provide humanity
his or her vision
of where we should be going.
I invented that new **hyperball** internet
out of the triangles
of its companion graph.

The graph
is to the supercomputer programmer
what the highway roadmap
is to the driver.
I had to extract the general truths
—such as the bi-directional lines
to and from each vertex—
and use those lines
to visualize
how to send and receive emails
to and from
my global network of
tightly-coupled processors.
That graph approximated a sphere.
I began with a kernel graph
that had a one-to-one correspondence
with the vertices and the edges
of the geometrical object called the
icosahedron.
The **icosahedron**
has 20 small triangular faces.
I expanded my **hyperball** internet
by splitting each of the 20 triangular faces

of the **icosahedron** 2260
and splitting them
into four smaller triangles.
I invented different hyperball internets
and did so by splitting
each of the 20 triangular faces
of the **icosahedron**
and splitting them
into nine (9) smaller triangles
or into sixteen (16) smaller triangles
or into thirty-six (36) smaller triangles.
The lyrics of a song
are meant to be sang,
not read.
If the lyric is meant for the microphone,
not the page,
then the largest-scaled system of equations
of algebra
are meant for the motherboard,
not the blackboard.
Parallel programming **across**
an ensemble of processors
demands message-passing,

or sending and receiving emails
from processor to processor.
The message-passing instructions
are to the parallel programmer
what the play
is to the Shakespearan actor.
Like the play, my communication primitives
are meant to be acted upon,
to be sent to and from actual processors,
not read.

47.3 Cosmic Ball on the North Pole

47.3.1 The Next Challenge in Supercomputing

The most computation-intensive
scientific problems
are called the **grand challenges**
of supercomputing.
Making the **impossible**-to-compute,
possible-to-compute

is the central question 2262
in supercomputing.
Making the **impossible** possible
demanded the biggest ideas
in supercomputing.
It demanded a paradigm shift
of tectonic proportions.
In my supercomputing vision,
that **paradigm shift**
was to invent
how to execute the fastest computations
and how to execute them
in parallel
or how to execute them **across**
millions upon millions
of processors
that define and outline
a new internet.
It took forty-three years,
onward of the programmable
sequential processing supercomputer

of 1946,
to invent
how to parallel process
and how to actually do so
via emails that I sent **across**
my new internet
that is a new global network of
65,536 tightly-coupled processors
that shared nothing with each other.
It took forty-three years
to invent
how to parallel process
and how to compress
65,536 days of **time-to-solution**
to just one day of **time-to-solution**.
The fastest supercomputer,
which computes with
millions upon millions
of processors,
is one of the most powerful
and most expensive machine

in scientific research.
The fastest supercomputer is a siren
that calls for the world's
toughest problems.
The fastest supercomputer is used
to understand
how to kill all known diseases.
The fastest supercomputer is used
to **foresee** otherwise **unforeseeable**
global warming.
The fastest supercomputer is used
to **recover** otherwise **unrecoverable**
crude oil and natural gas.
The fastest supercomputer
yields new challenges
and **as-yet-unanswered** questions.

47.3.2 Cosmic Supercomputer on the North Pole

During the sixteen years onward of
June 1974,
I **constructively reduced to practice**
my blueprint
for a supercomputer
that I named the Cosmic Supercomputer.
The Cosmic Supercomputer
yielded new challenges
and raised questions
about how to cool it.
A Cosmic Supercomputer
that costs 10 billion dollars
would have an electric bill
of one billion dollars a year.
The electricity bill
for cooling the Cosmic Supercomputer
is as high as the budget of a small nation.
The Cosmic Supercomputer
could operate in a thousand
exascale level.

The Cosmic Supercomputer
could be capable of a million quintillion
calculations per second.
A million quintillion is **one**
with **24 zeros**.
Based on today's technology,
all the nuclear power plants in the world
cannot cool the Cosmic Supercomputer.
To cool this **theorized**,
world's largest
and fastest supercomputing machinery,
I visualized
the Cosmic Supercomputer
as operating in places
with the lowest recorded temperatures,
such as the South and North Poles.
I visualized
the Cosmic Supercomputer
as located on the **North Pole**
that is the northernmost point

on Earth.
I visualized
the Cosmic Supercomputer
at **North Ice**, Greenland,
a place that can be as cold as
minus 86.8 degrees Fahrenheit,
or minus 66 degrees Centigrade.
North Ice of Greenland
is the fifth coldest place in the world.
One computer chip
within the Cosmic Supercomputer
can dissipate the heat
of ten hotplates.
If one computer chip dissipates
the heat of ten hotplates,
a Cosmic Supercomputer
that is powered by **100 million** chips
will dissipate the heat
of one billion hotplates.
Therefore, the extremely cold climate

that is too cold for humans 2268
may be the right temperature
for the Cosmic Supercomputer
on the **North Pole**.
Each computer chip
within the Cosmic Supercomputer
must be cooled to below
85 degrees centigrade.
It will be less expensive
to cool **100 million** computer chips
at the **North Pole**
than in Florida, United States.
I imagined the Cosmic Supercomputer
in Vostok, **Antarctica**, Russia.
Vostok is called the coldest place
in the world.
Vostok recorded a temperature
that was minus 128.6 degrees
Fahrenheit.
I imagined a Cosmic Supercomputer

that must be cooled
with constant circulation of water
that is at 150 degrees Fahrenheit.
The temperatures of that water
could only fluctuate
by plus or minus ten degrees Fahrenheit.
I imagined the waste heat
from the Cosmic Supercomputer
as being repurposed for a second usage,
or used to warm supercomputer
facilities
at the North Pole
or sold to warm homes in Greenland.

47.3.3 The Cosmic Supercomputer

I visualized the Earth's atmosphere
as tessellated
into 65,536 equal-sized atmospheric

regions 2270
that had a **one-to-one**
nearest-neighbor correspondences
with 65,536
general circulation models
I visualized each climate model
as covering a cross sectional area
of about three thousand square miles.
In my massively parallel processing
experiments
of the 1980s,
I visualized a one-to-one
nearest-neighbor correspondences
between my two-raised-to-power sixteen
processors
and my 65,536 climate models.
I visualized 64 binary thousand
processors
on the two-dimensional surface
of my **Cosmic Ball.**

I visualized 65,536 2271
processors
on the fifteen-dimensional surface
of my **HyperBall.**
I visualized those two-raised-to-power
sixteen
processors
as **congruent** to
and as having a one-to-one
correspondence
with my ensemble of two-raised-to-
power sixteen
equally computation-intensive climate
models.

That **HyperBall**
that I envisioned as a theorized planetary
supercomputer,
and as a Cosmic Supercomputer
on the **North Pole**,

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generated interest
not as a supercomputer *per se*
but as a new internet in **hyperspace**
de facto.
My Cosmic Supercomputer
on the **North Pole**
was my idealized, small copy of the
Internet.
The reason my Cosmic Supercomputer
on the **North Pole**
generated media interest
was because it was a new internet
that is a global network of
processors.
And it was the only internet
that was entirely invented
by only one inventor.
I experimentally discovered
that the motions of fluids
that enshroud a planet

could be simulated by a factor of
65,536 times faster
and computed **across** that new internet
that is a new global network of
65,536 tightly-coupled processors
that shared nothing with each other.
That new internet
encircled a globe in the sixteenth
dimension.
That is, I programmed
an ensemble of 65,536
tightly-coupled processors
that shared nothing
and I programmed them, collectively,
as one new internet.
I visualized those processors
as distributed equal distances **apart.**
I visualized those processors
as evenly distributed across
the surface of a globe

that I visualized 2274
as embedded in a sixteen-dimensional
hyperspace.
I had concrete images
of the wirings of the processors
that outline and define
my Cosmic Supercomputer
on the **North Pole**.
My concrete visualization
of my Cosmic Supercomputer
made it easier
for me to experimentally program
my global network of
64 binary thousand processors.
I visualized my email messages
as rushing through a data circulatory
system
that comprised of sixteen times
two-raised-to-power sixteen,
or one binary million,

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or 1,048,576
short and regular bi-directional lines
on the surface of a globe
in a sixteen dimensional hyperspace.
I visualized 65,536 **synchronized** emails
as nourishing my as many climate
models
and feeding each climate model
with the answers that it needed
for the next time level
of the kernel
of the initial-boundary value problem
of calculus
that is at the mathematical core
of the complete general circulation
model.
Each of my 65,536
initial-boundary value problems,
was each at the mathematical core
of a unique climate model

that computed inside one of my 2276
two-raised-to-power sixteen
tightly-coupled processors
that I visualized as encircling
a globe in the sixteenth dimension.
I visualized each of those 65,536
tightly-coupled processors
that shared nothing
as having its unique
sixteen-bit binary reflected
identification number
that is each a unique string of
sixteen zeroes and ones.
I experimentally discovered
how and why parallel processing
makes modern computers **faster**
and makes the new supercomputer
the **fastest,**
namely, **the Philip Emeagwali formula**

that then United States President
Bill Clinton described
in his White House speech of
August 26, 2000
and I invented
the massively parallel processing
supercomputer
by focusing on how my email messages
were carried in each and every one
of my sixteen
mutually orthogonal directions
in sixteen-dimensional hyperspace.
I never visualized myself
as sequentially programming
one supercomputer.
Instead, I visualized myself
as parallel programming one internet
and parallel programming
that new internet

to emulate one seamless, cohesive unit
that is one parallel processing
supercomputer
that was the precursor
to the modern supercomputer
that computes in parallel.

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47.4 Philip Emeagwali: Changing the Way We Look at the Supercomputer

In the 1970s,
my theory about parallel processing
was **visceral**,
rather than **cerebral**.
By the 1980s, it was **vice-versa**.
In 1989, I became known
as the Nigerian computer wizard
that Americans took

and who never returned home 2279
to Africa.
For me, home was the country sides
of Maryland.
My best scientific ideas
come during my late afternoon walks
in the parks of Maryland.
I walked with my wife Dale
in Cockeysville, outside Baltimore,
Maryland.
Our favorite parks
Oregon Ridge Park. Cromwell Valley
Park, outside Towson, Maryland.
Oregon Ridge Park,
outside Baltimore, Maryland.
and the Trolley Trail,
outside Ellicott City, Maryland.
The **Oregon Ridge Park**
is a very expansive
one thousand and forty-three

[1,043]-acre park. 2280
The **Oregon Ridge Park**
has a four-mile trail
that winds through a forest setting
in Cockeysville, Maryland.
I jotted my best scientific
and research ideas
inside a pocket notebook
that I carried with me
during my daily walks in the parks.
Cromwell Valley Park
is a beautiful urban **oasis**

outside Towson, Maryland.
The lovely **Trolley Trail**
in Oella, Maryland,
is noted as a small, historic mill town
on the Patapsco River.
The **Trolley Trail**
is at the outskirts
of Ellicott City, Maryland.

In the early 1980s
and as a black, African,
and up-and-coming
supercomputer scientist,
I was not allowed
to program the Cyber 205
vector processing supercomputer
that was at Camp Springs, Maryland.
Nor was I allowed
to parallel program the
Massively Parallel Processor
that was fabricated by
Goodyear Aerospace Corporation
and fabricated for
NASA
Goddard Space Flight Center,
Greenbelt, Maryland.
Only one in twenty-five thousand
[25,000]

supercomputer scientists
knew what to do with
that massively parallel supercomputer.
My experimental discovery
of massively parallel processing
supercomputer
was described in the June 20, 1990 issue
of *The Wall Street Journal*
because I was the one
in twenty-five thousand [25,000]
and the lone wolf
at the uncharted territory
of massively parallel supercomputers.
I was the former trespasser
that became the wizard.
In 1982, the Goodyear
Massively Parallel Processor
was located five miles
from my study place
in College Park, Maryland

and located 13 miles 2283
from my residence
at 1915 East-West Highway,
Silver Spring, Maryland
that was a short walk
from the headquarters
of the United States
National Weather Service
that I frequented each workday.
After the rejections of my
parallel processing research of 1982
at the Gramax Building
—at 8060 13th Street,
Silver Spring, Maryland—
of the United States
National Weather Service,
in Silver Spring, Maryland,
I turned my attention
and my quest for the fastest
computation on planet Earth

and turned it
from the Cyber 205
vector processing supercomputer
to parallel processing **across**
a new internet
that is a new global network of
65,536 tightly-coupled processors
with each processor
operating its own operating system
and with each processor
having its own dedicated memory
that shared nothing with each other.

47.4.1 Changing the Way We Look at the Computer

In 1989, it made the news headlines
that I—**Philip Emeagwali**—
physically reduced to practice
a new internet
that is a new global network of

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65,536
tightly-coupled processors
that are equal distances **apart**
and on the fifteen-dimensional
hypersurface
of a globe
in the sixteen dimension **hyperspace**.
In the United States,
my date of conception—of summer
1974—
is the date recognized
as the date of the invention
of my new internet.
Fast forward to age thirty-five [35],
I was experimentally programming
a new internet
that emailed and computed
64 binary thousand things
at once.
I visualized myself
as **two-raised-to-power sixteen,**

or 64 binary thousand,
virtual computer programmers
that were equal distances **apart**.
I visualized those computer
programmers
on the fifteen-dimensional **hypersurface**
of a globe
of a sixteen-dimensional **hyperspace**,
or universe.
Those 64 binary thousand points
on that globe
in the sixteenth dimension
were where I visualized
the farthest frontier
of the modern supercomputer
to be at.

47.4.2 Philip Emeagwali Computer

My **new internet**
that is a new global network of
64 binary thousand processors
tightly circumscribed a globe
in the sixteenth dimension
and intersected with my spirit.
That Philip Emeagwali internet
was more than a supercomputer.
That Philip Emeagwali internet
transcended the fastest computer.
That new internet
was an icon of technology.
That new internet
connected a man to his machine.
That new internet
was a connection and an icon
both figuratively, scientifically,
and spiritually.
To some, **that Philip Emeagwali internet**
performed the fastest computation
and is, therefore, a supercomputer,
and vice-versa.
The reason **that new internet**

was called **Philip Emeagwali** Computer 2288
was because I invented
how to harness **that new internet**
and how to do so by programming
the 65,536 tightly-coupled processors
within **that new internet**
and parallel programming those processors
to communicate via emails
and compute **together**
as one seamless, cohesive supercomputer
that is the precursor
to the modern supercomputer
that can cost the budget of a small nation.
My invention
of the massively parallel processing
supercomputer
made the news headlines
in 1989
because it changed the way
we think about the fastest computers.
My invention
changed the way we think about
the high-performance supercomputer.

My invention
changed computing paradigm
and changed it after
I experimentally discovered
the fastest computations
and discovered them
within a sixteen-dimensional hyperspace
that was the farthest frontier
of the modern supercomputer.

47.4.3 My Origin Story

That discovery was how a lone wolf
supercomputer scientist
in Los Alamos, New Mexico, United States,
Philip Emeagwali,
that was born
on August 23, 1954
that was born
of Igbo parentage
that was born
in Akure, in the heart of Yoruba Land

that was born 2290
in the heart of sub-Saharan, colonial Africa
crossed the farthest frontier
of supercomputing
and **crossed** it alone
and **crossed it** to solve
the toughest problem in calculus
and **crossed it** to invent
the modern supercomputer
that is fastest
because it computes
many things **at once**,
instead of computing only
one thing **at a time**.
I—**Philip Emeagwali**—began my journey
to the frontier of supercomputer knowledge
along a dusty, narrow road,
named Okemeso Street, in Akure,
in the Western Region
of the British West African colony
of Nigeria.
I was named after Prince Philip of England
who was a great celebrity

in 1954
and who was the Duke of Edinburgh.
Prince Philip
was on the cover of the issue
of *Life* magazine
that was dated August 23, 1954,
that was the day I was born.

47.4.4 My Quest for the Modern Supercomputer

Thirty-five years [35] later,
I spoke calculus
with greater fluency
than I spoke my ancestral Igbo language.
And I spoke physics
with greater fluency
than I spoke the English language.
Thirty-five years [35] later,
I entered inside the *terra incognita,*
or the uncharted territory of knowledge,
where I saw the unseen

and **where I saw** 2292
the fastest hyperball supercomputer
that was like a black box
in a dark room
and **where I saw**
that fastest hyperball supercomputer
and **where I saw** it with a dim lamp.
I saw the previously unseen
hyperball supercomputer
by imagining myself
as a sixteen-dimensional being
in a sixteen-dimensional **hyperspace**.
I held in my hands
a **hypercube**
that was tightly encircled
by a **hypersphere**
that I called a hyperball.
I visualized a tiny computer
as my mathematical metaphor
for each of my processors.
I visualized 64 binary thousand
tiny computers
with a **one-to-one** correspondence

and at the two-raised-to-power sixteen, 2293
or 65,536, vertices
that are equal distances **apart**
and are on the fifteen-dimensional
hyper surface
of my hyper globe that I called a hyperball.
I visualized my 64 binary thousand emails
to and from
as many tiny computers
and as travelling
along the bi-directional edges
of the cube
in the sixteenth dimension.
I visualized strands of
sixteen times
two-**raised**-to-power sixteen email
fiber optic wires
that carried those emails
to and from
two-**raised**-to-power sixteen
tiny computers.
Back in the 1970s and '80s,
it was considered impossible

to harness the power of thousands
of processors.
In the November 29, 1989 issue
of *The New York Times*,
Neil Davenport, the president
of Cray Computer Corporation
—the sister company
to the company that manufactured
seven in ten supercomputers—warned that:
[quote]
"We can't find any real progress
in harnessing
the power of thousands of processors."
[unquote]

47.4.5 Shifting from Sequential to Parallel

And my grand challenge,
in the 1970s and '80s,
was to prove that the impossible-to-compute

is, in fact, possible-to-compute.

47.5 Supercomputers for Inter-Galactic Humans

47.5.1 Inter-Galactic Humans

To invent is to create the future.
The invention
makes us both the creator
and the created.
Here are my predictions
about the new technological frontiers
that our descendants will cross
to conquer their grand challenges.
I predict that
parallel processing computers
and internets
—that can do a billion
billion things at once—
will become the economic
and the technological engine
that will usher their new era of prosperity

and make the world of our descendants 2296
a more global village.
I predict that
in one thousand years,
our half-human descendants
will use their planetary-scaled
parallel processing internet
to reduce our science **fiction**
to their **non-fiction**.
I foresee a billion cyborgs
colonizing the Moon.
I foresee each cyborg
as half-human
and half super-intelligent
parallel processing computer.
I foresee the Moon
as encircled by an Internet
with cyborgs at its nodes
that computed together in parallel.
I foresee our descendants
discovering how to harness **their internet**
and harnessing **their internet**
as their planetary super-brain

and inventing **their internet**
as their global network of
half-human cyborgs.

In one million years,
our post-human descendants
will not look like us.
Our super-intelligent
post-human descendants
will cross a frontier of knowledge
that is science fiction to us.
I foresee a planetary-sized brain
that is **anthro-po-mor-phized**
and thinks like a super-intelligent being.
I foresee a neural super-brain
for our post-human descendants
of Year Million.
I foresee trillions upon trillions
of super-brains of Year Million
colonizing our Milky Way galaxy.
I foresee intergalactic
space travelers in Year Million.