[illegible]

Brian P. Schmidt

CAASTRO
ALL-SKY ASTROPHYSICS

Australian National University

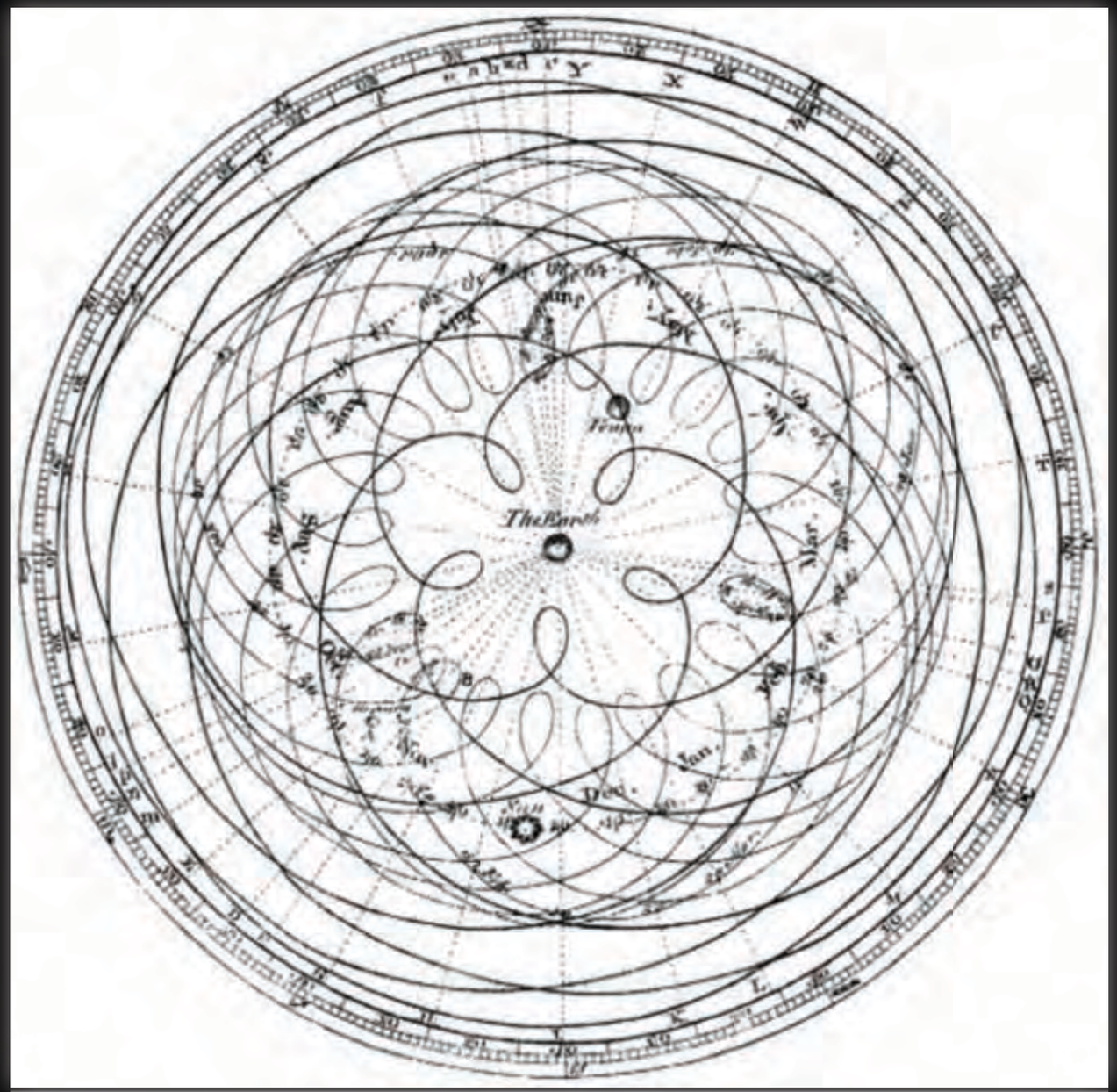
The Research School of Astronomy & Astrophysics
Mt Stromlo Observatory

- Greeks: Seven Sisters
- Australian Aboriginals: Seven Sisters
- Ancient India: Seven Virgins
- Thailand: ดาวลูกไก่ (The 7 chicks)

Every Human has Shared the Stars

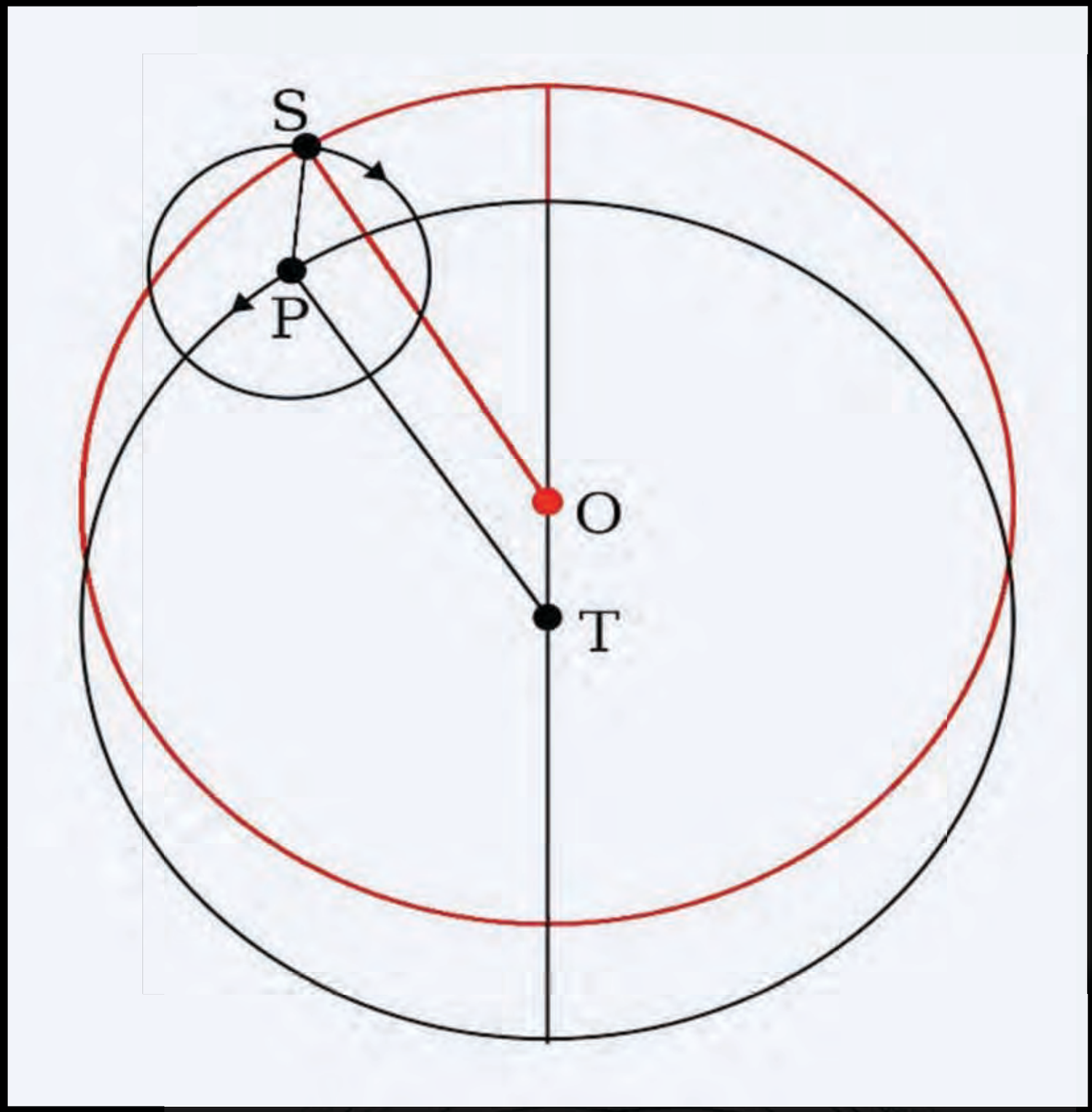
17300 Years ago… The Pleiades next to Taurus (The Bull)

Πτολεμαῖος

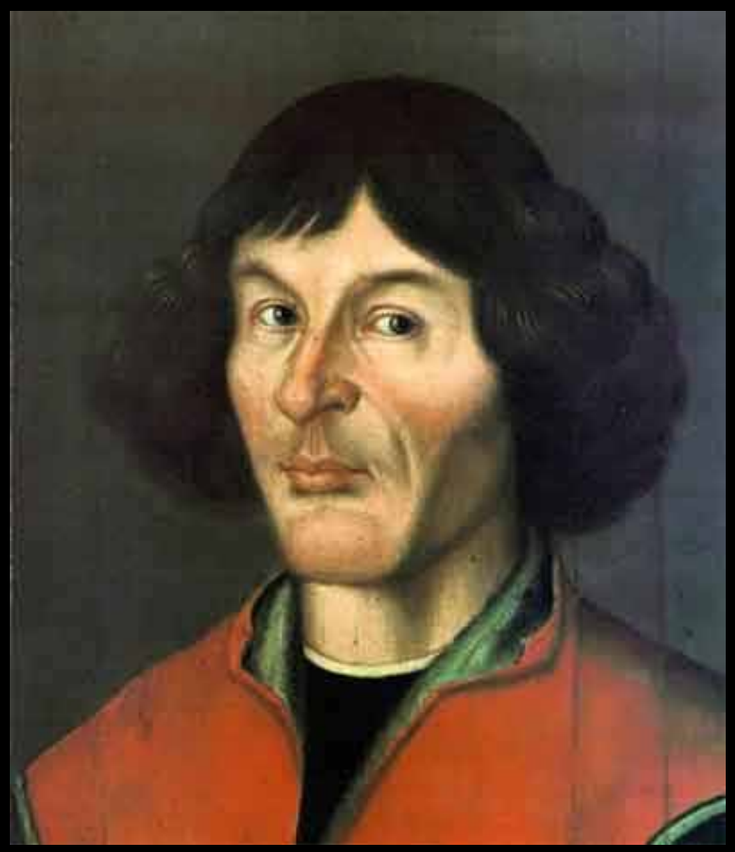


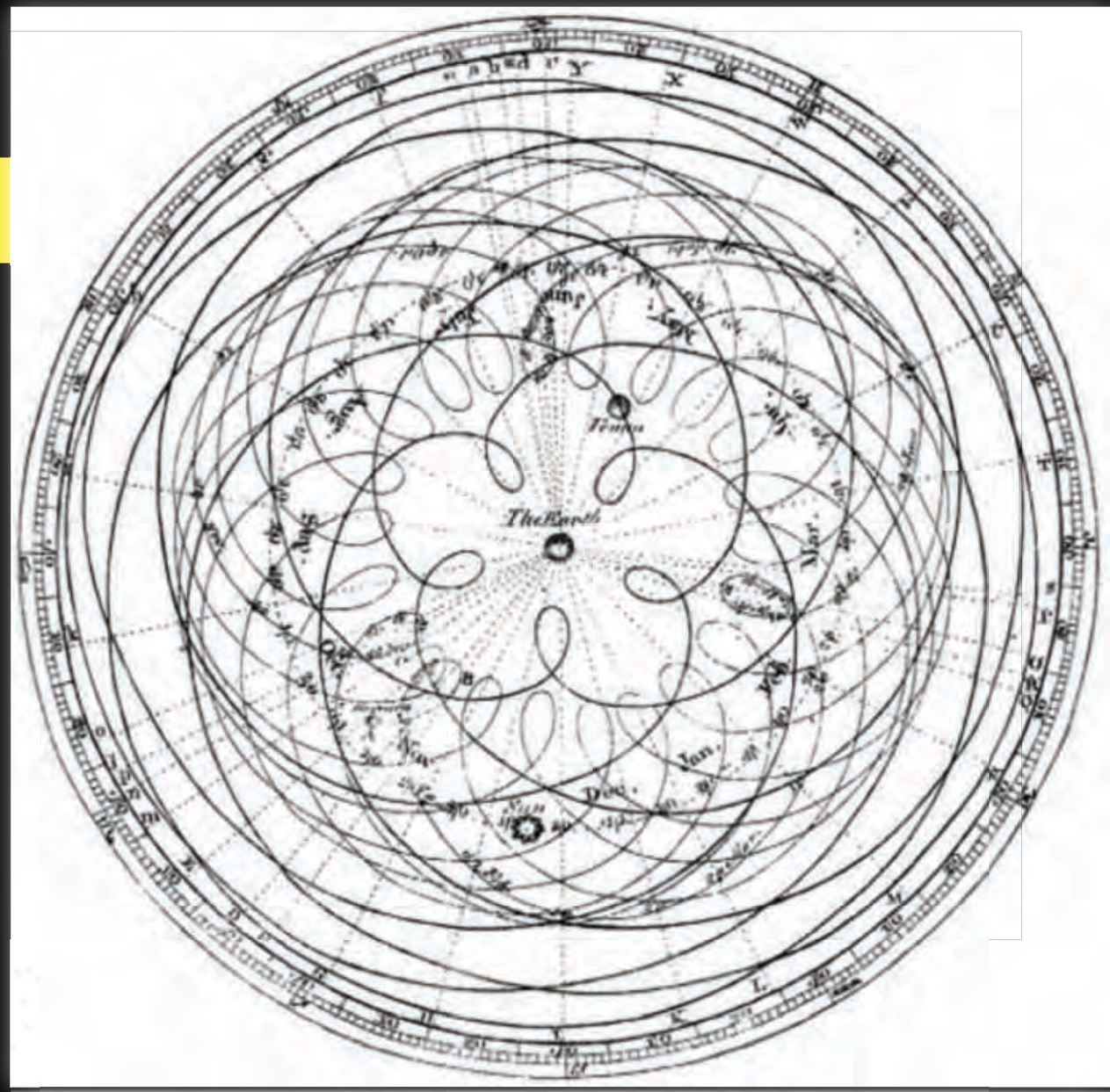
Πτολεμαῖος

- Built on Axioms
  - Earth is at the Centre
  - Objects travel in Circles



Copernicus' view of the Solar System was theoretical



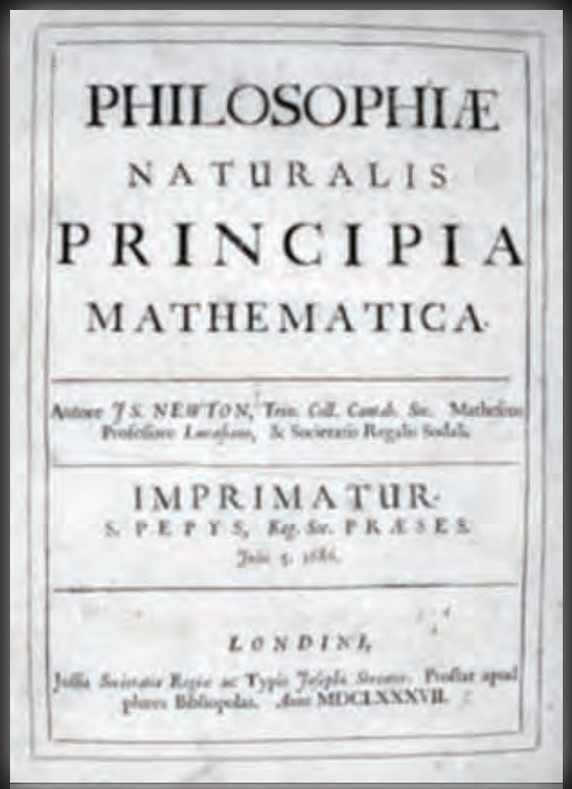


But to Galileo, a planet
became this...

A Manifestation of
What Copernicus Predicted.

Newton

- Provided a Powerful Mathematical Framework
- Allowed Precise Prediction, and therefore falsification

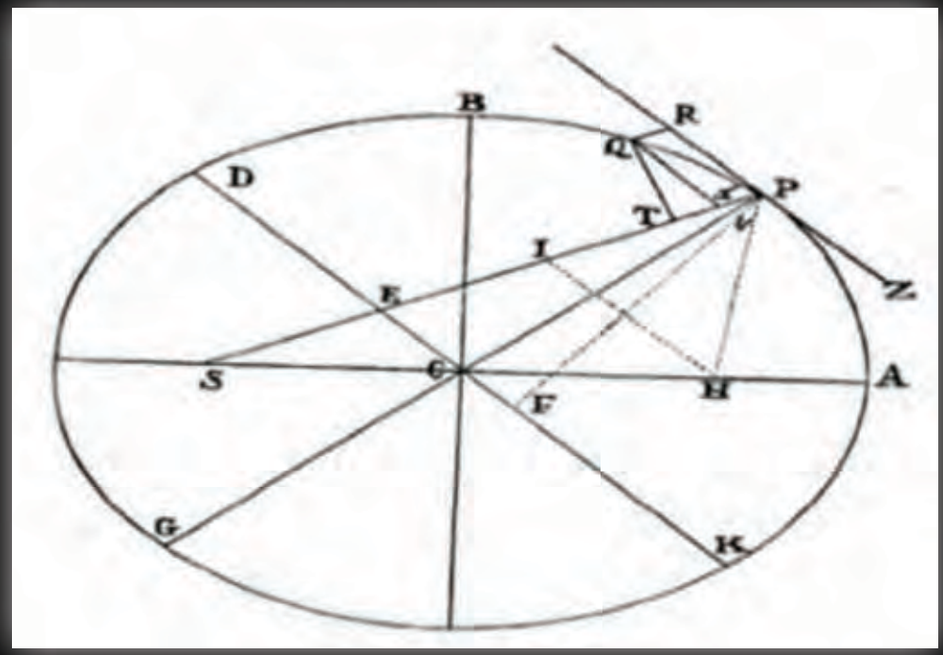


PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA

Autore *Is. NEWTON*, Trin. Coll. Cantab. Soc. Matheseos Professore Lucasiano, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, Reg. Soc. PRÆSES.
Julii 5. 1686.

LONDINI,
Jussu Societatis Regiæ ac Typis *Josephi Streater*. Prostat apud plures Bibliopolas. Anno MDCLXXXVII.

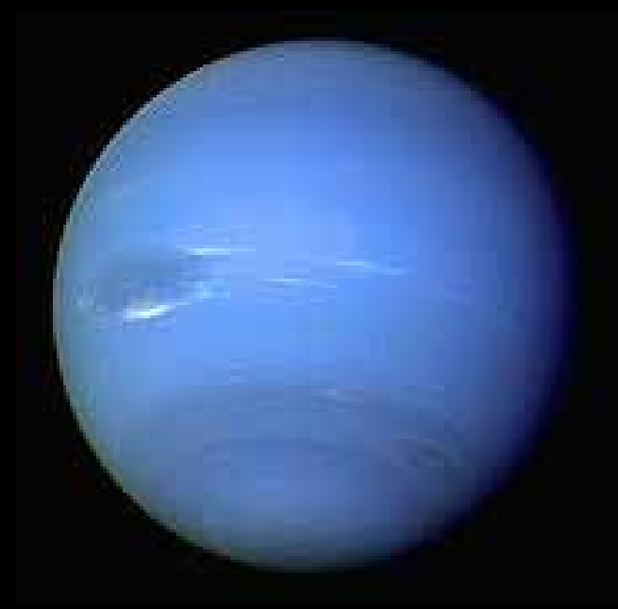


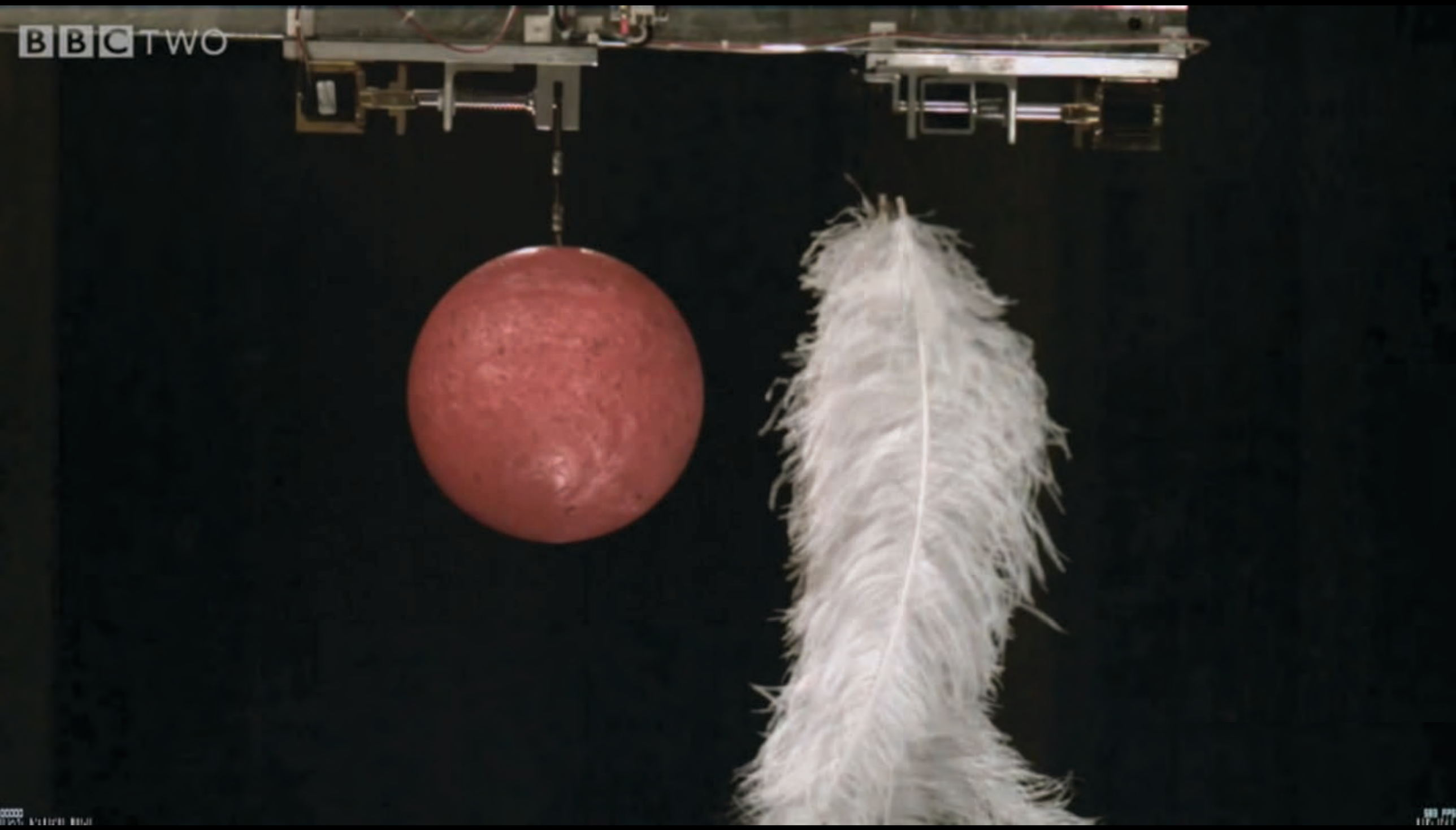
Telescopes and the Discovery of Planets

1781

Neptune Predicted By its in□uence on Uranus' Orbit

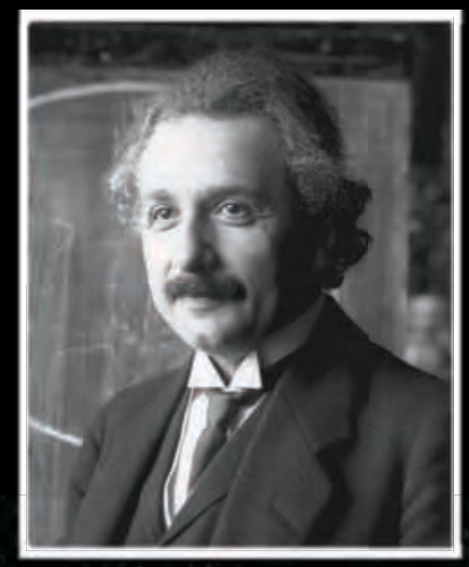
- Urbain Le Verrier in Paris, used Mathematics to Predict where the New planet should be...
- Johann Gottfried Galle in Berlin promptly discovered the new Planet in 1846




BBC TWO

Einstein's Theory of Gravity

In 1907 Einstein had a revelation that acceleration and gravity were indistinguishable.



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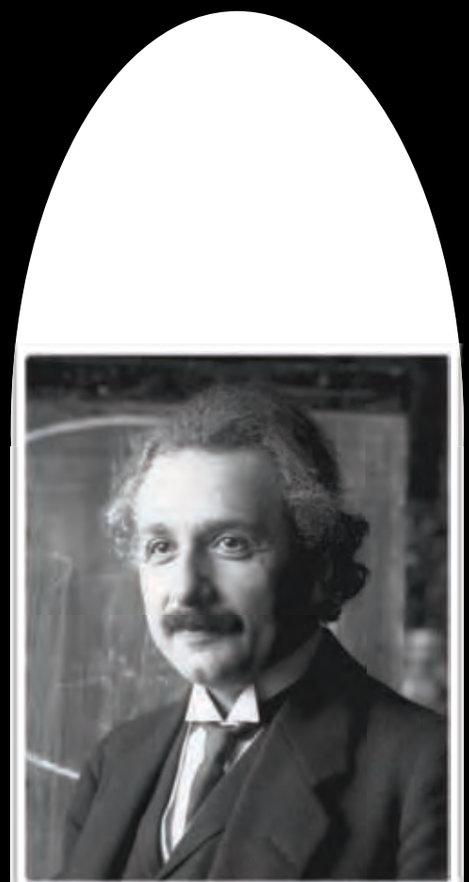
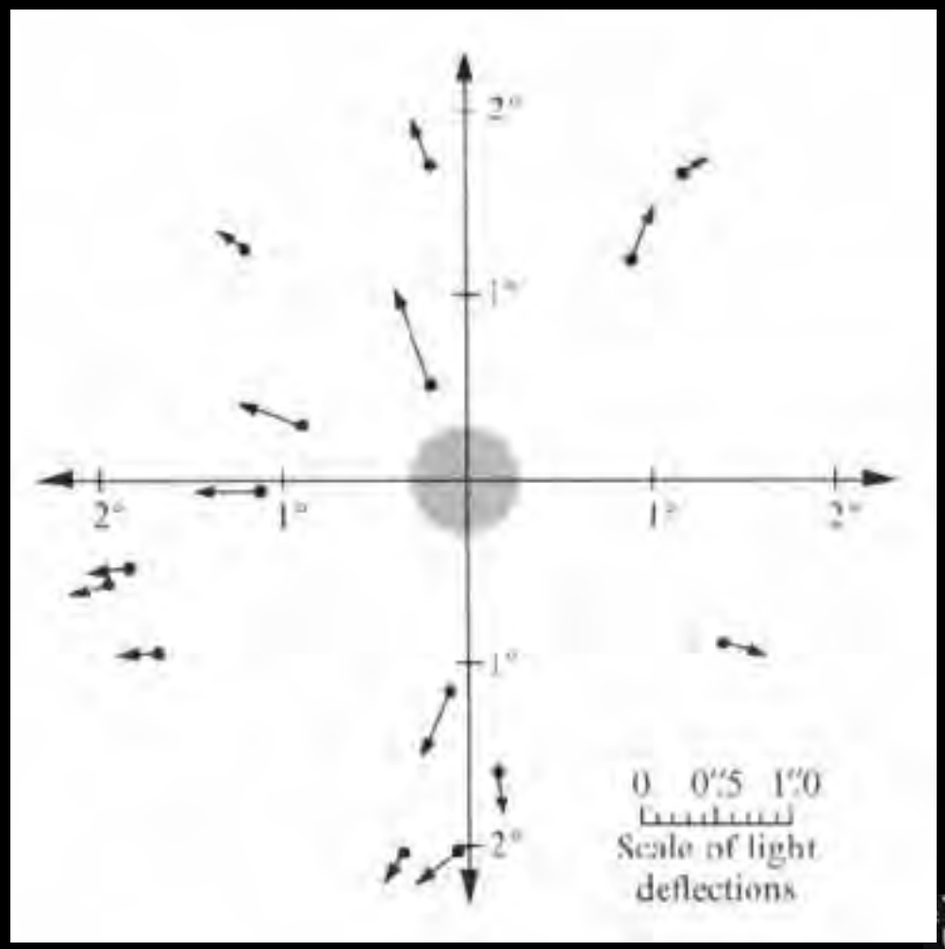
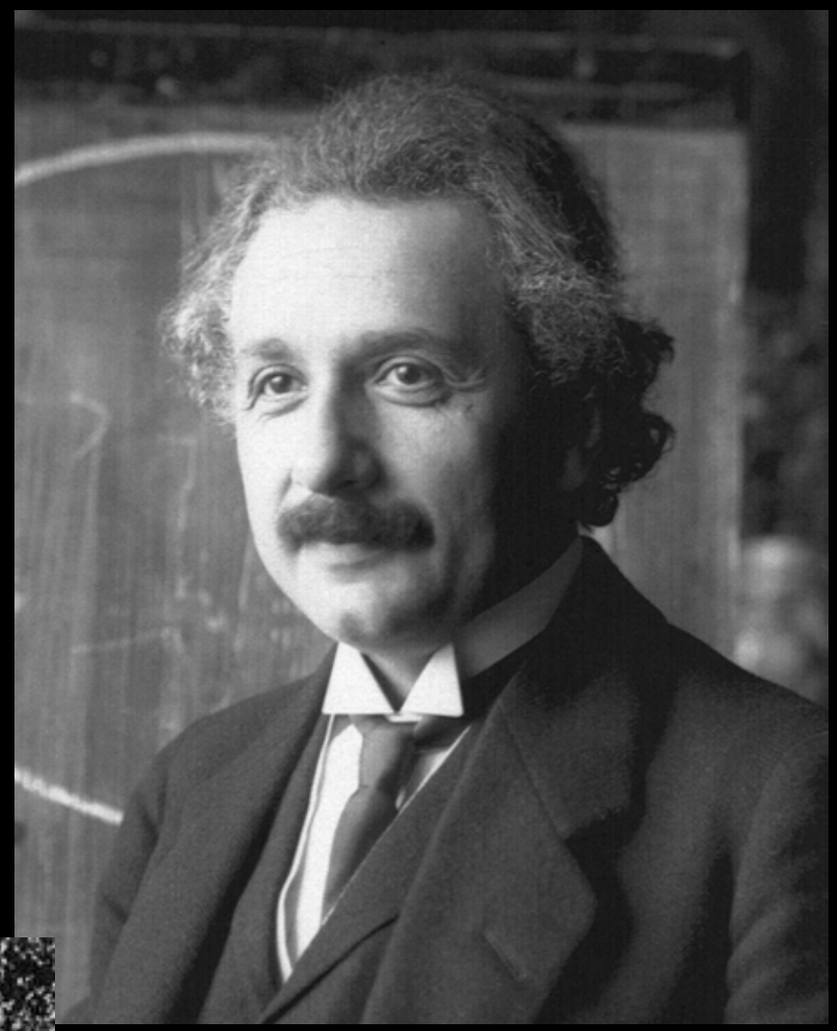
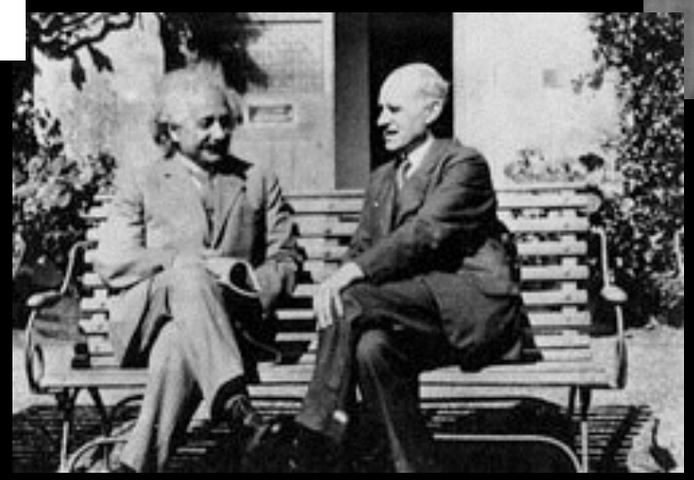


And Telescopes Vindicated Einstein's theory of Gravity







And Telescopes Vindicated Einstein's theory of Gravity

LIGHTS ALL ASKEW IN THE HEAVENS

Men of Science More or Less Agog Over Results of Eclipse Observations.

EINSTEIN THEORY TRIUMPHS

Stars Not Where They Seemed or Were Calculated to be, but Nobody Need Worry.

A BOOK FOR 12 WISE MEN

No More in All the World Could Comprehend It, Said Einstein When His Daring Publishers Accepted It.

What is Reality?

Reality is a set of ideas which predict the observations we make

Why do we Do Science?

Because it is interesting!

Why do Governments Pay for Science?

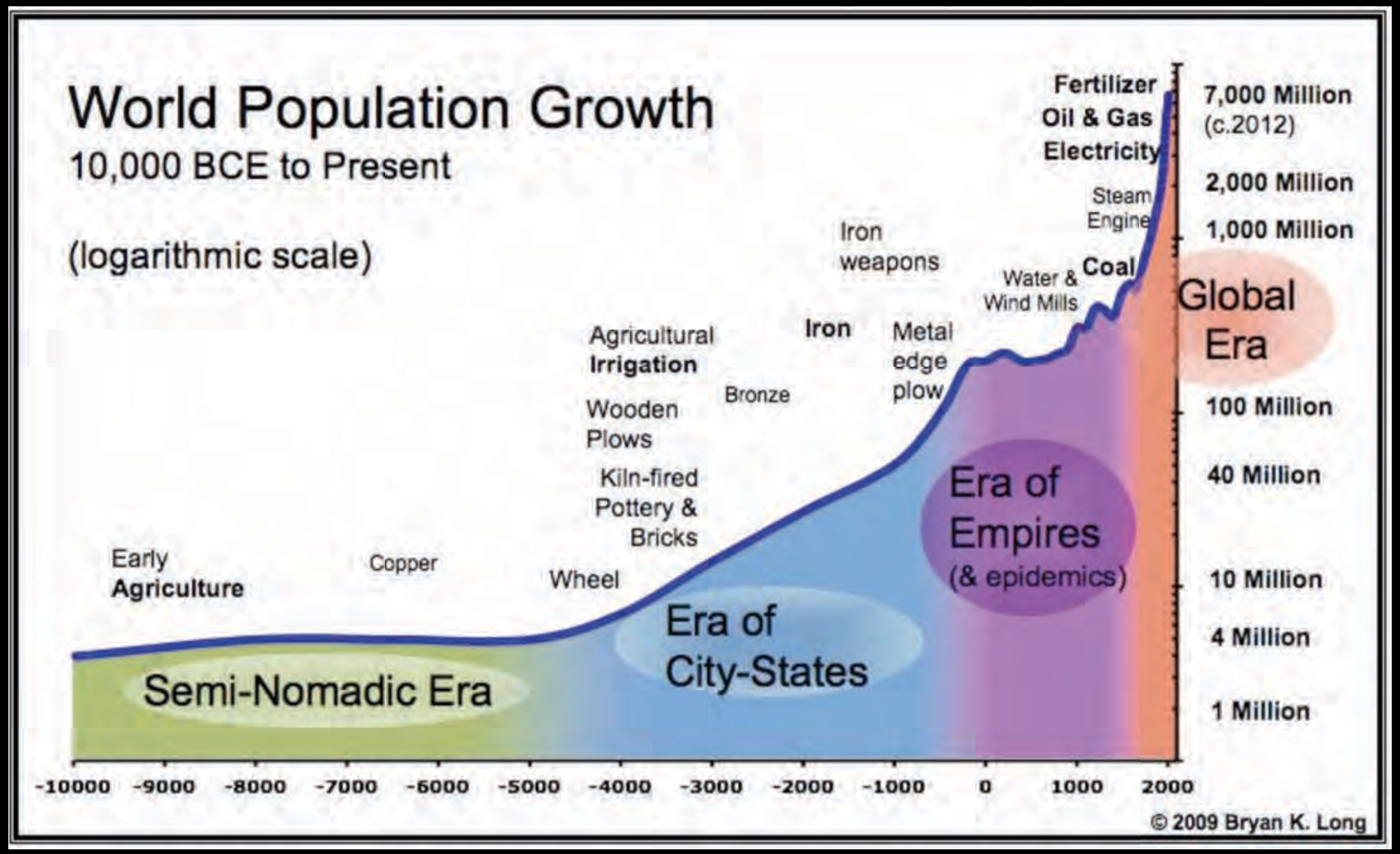
Because it is valuable!

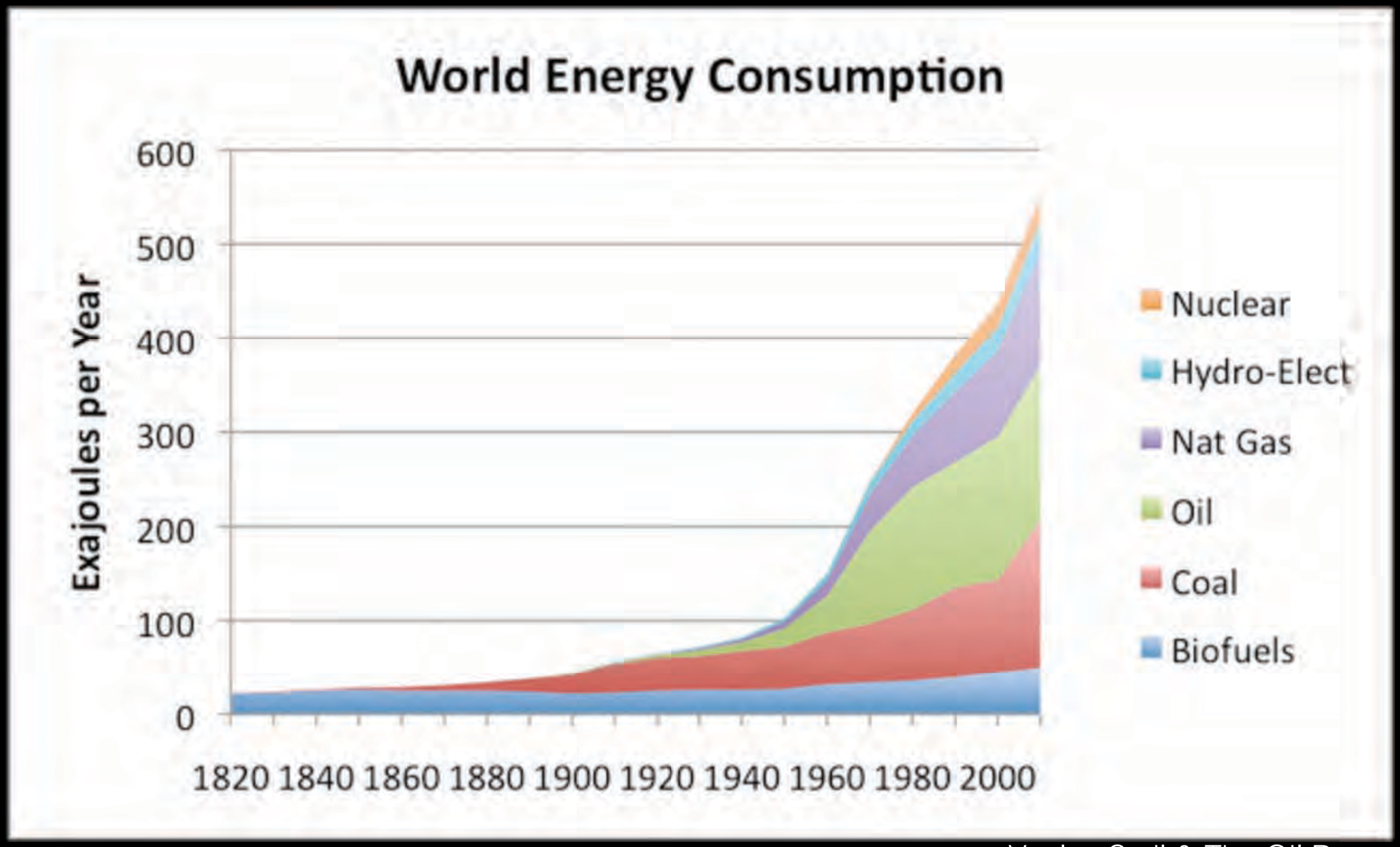
Being able to predict what happens given a set of circumstances is the basis of the technology that drives the modern world

Science Has Transformed Humanity

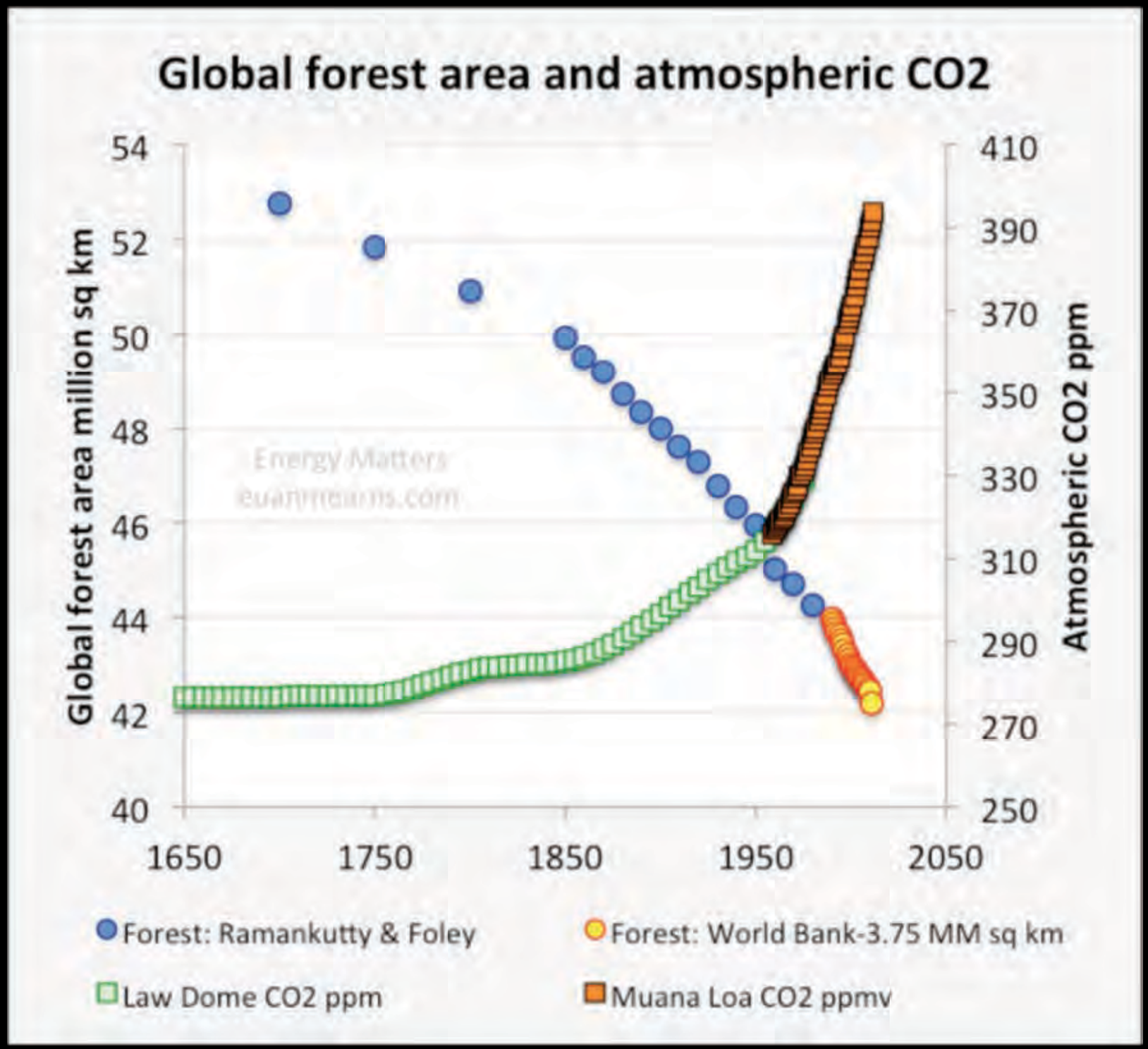
Paleolithic		32 years
Greeks		28 years
Romans		30 years
Medieval Britain		30 years
World 1910		31 years
World 2010		67 years

But at a Price





Vaclav Smil & The Oil Drum

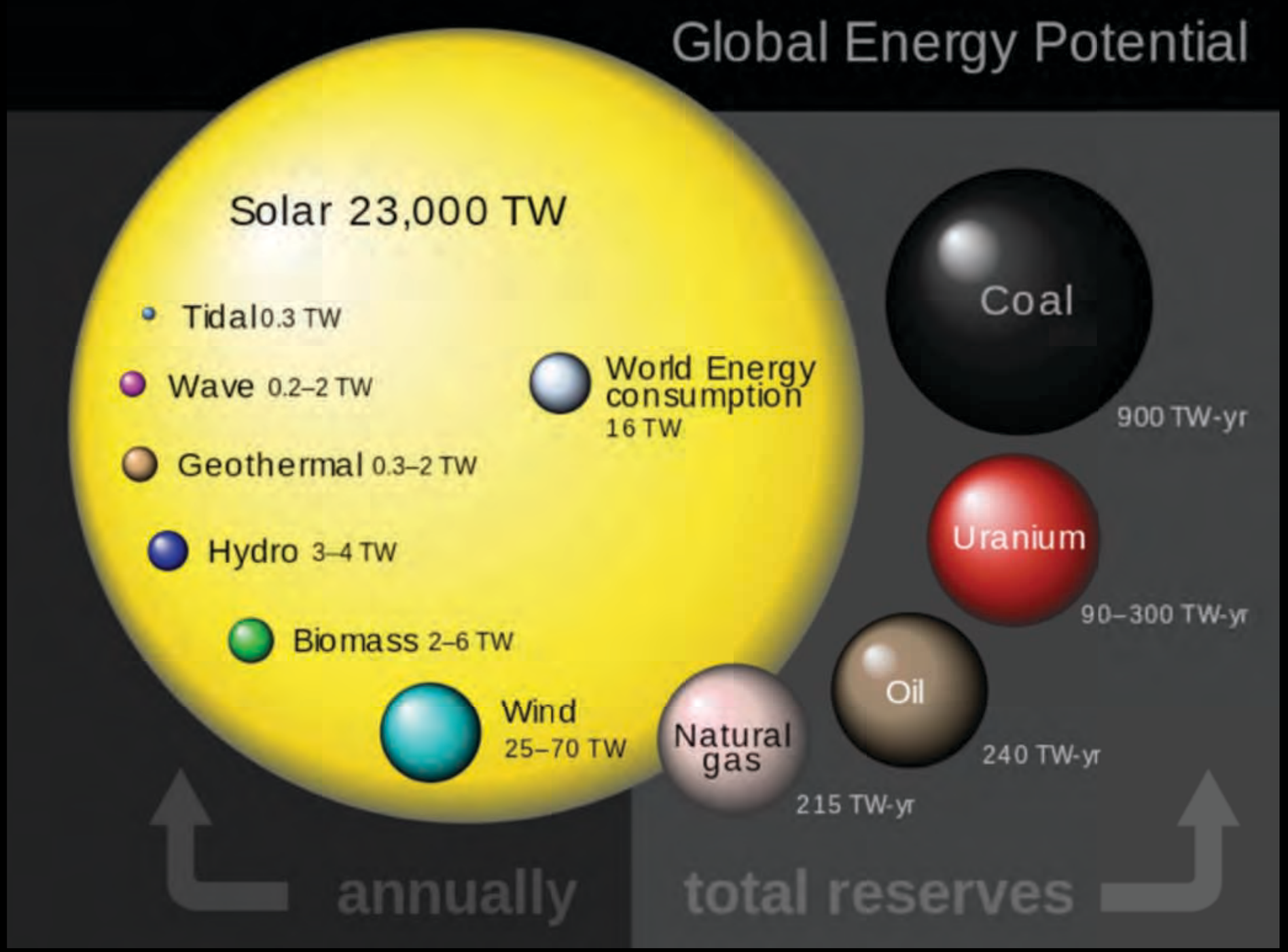

Global forest area and atmospheric CO2
Global forest area million sq km
Atmospheric CO2 ppm
54
52
50
48
46
44
42
40
410
390
370
350
330
310
290
270
250
1650
1750
1850
1950
2050
Energy Matters
euanmearns.com
Forest: Ramankutty & Foley
Forest: World Bank-3.75 MM sq km
Law Dome CO2 ppm
Muana Loa CO2 ppmv

Technology can be a doubled edged Sword

- While Technology Can help Make life better, it can also make its own problems
- For Humanity's future - it is imperative that we focus on using science and technology to solve the world's long term problems - not just short term ones

And Science Can Help

- With Abundant Energy, The Earth can support the 8-billion people it will soon have on it.


Global Energy Potential
Solar 23,000 TW
Tidal 0.3 TW
Wave 0.2–2 TW
Geothermal 0.3–2 TW
Hydro 3–4 TW
Biomass 2–6 TW
Wind 25–70 TW
World Energy consumption 16 TW
Coal 900 TW-yr
Uranium 90–300 TW-yr
Oil 240 TW-yr
Natural gas 215 TW-yr
annually
total reserves

But Science Can only be the Bridge

- Science can provide the means to prosperity, but only if
- Humanity is willing to share the world, the technology, and the a uence that each person on Earth wants for their own.
- And while science is our best means to find solutions, it is not guaranteed to find one, or find one quick enough

Science is Already a Bridge

International Space Station crew take shelter after alarm in US section; NASA dismisses reports of ammonia leak

Updated Thu at 6:20am

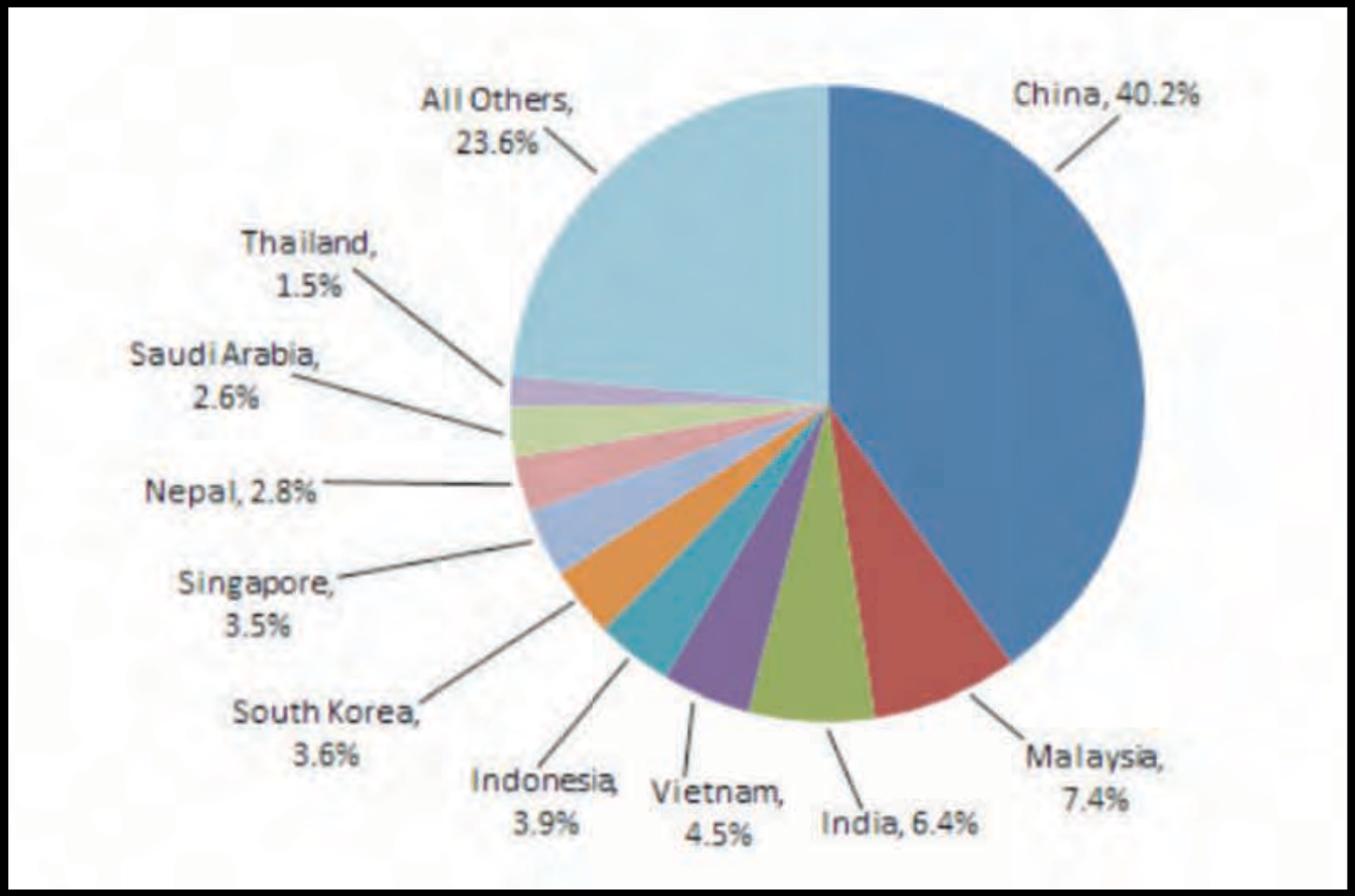
Astronauts at the International Space Station have been forced to evacuate the American section of the orbiting outpost after an alarm indicated a possible ammonia leak, the US space agency NASA said.

The six-member crew donned emergency masks and hurried to the Russian side of the station, closing the hatch to the US side behind them.

While the Russian space agency told news outlets in Moscow that the cause was a toxic ammonia leak, NASA said a closer analysis of the data pointed to a false alarm, and stressed that the crew was safe.

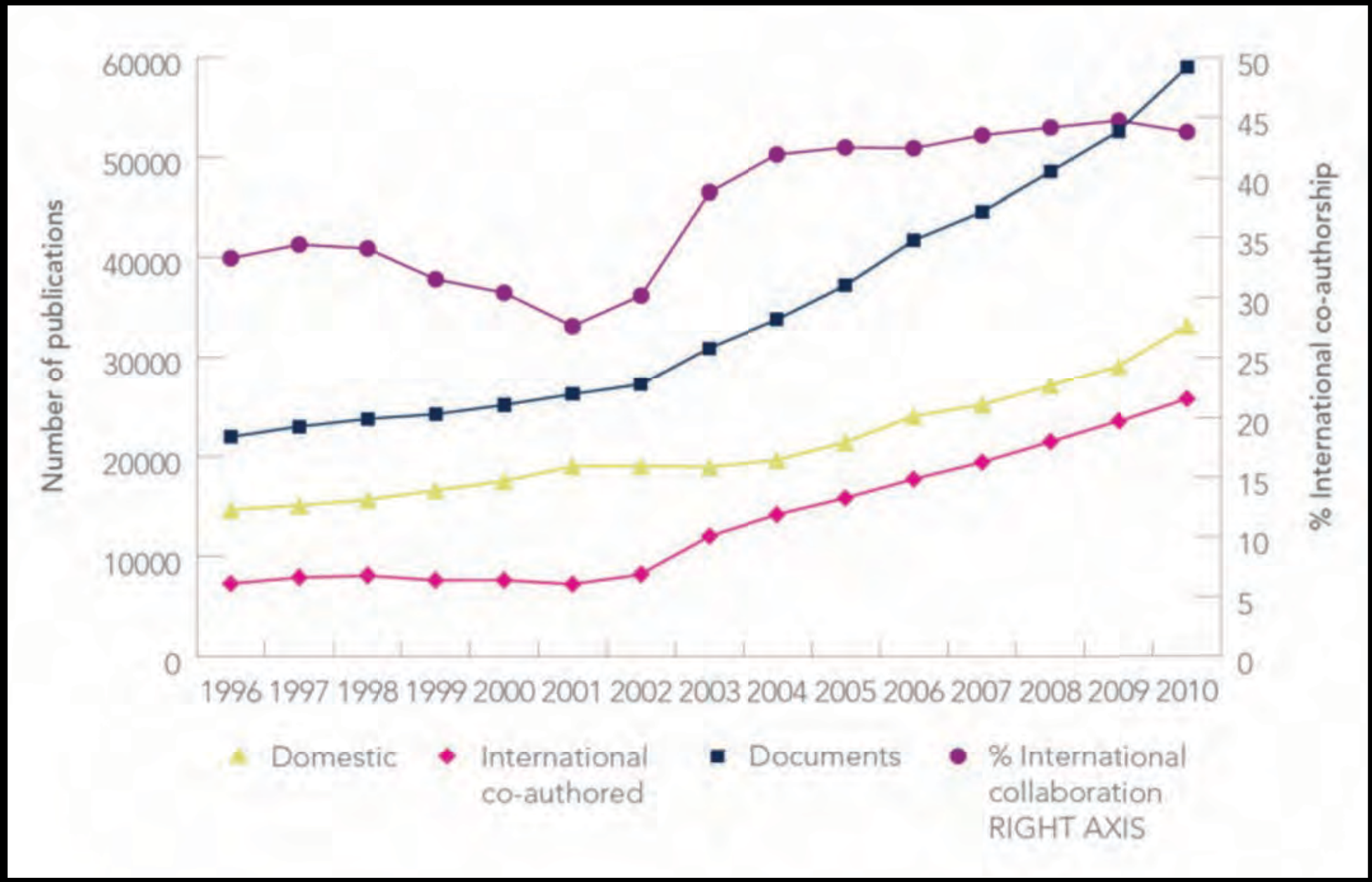
PHOTO: Crew from the International Space Station were forced to move into the Russian segment after the alarm was raised. (AFP: NASA)

Foreign Students Studying in Australia



233,000 students or 22% of all students

Scientific Collaboration in Publications



Collaboration Index			
Country	1995	Country	2010
New Zealand	4.49	New Zealand	3.92
Singapore	2.01	Singapore	1.66
South Africa	1.86	South Africa	1.5
China	1.11	United Kingdom	1.16
Iran	1.11	Iran	1.13
United Kingdom	1.05	China	1.06

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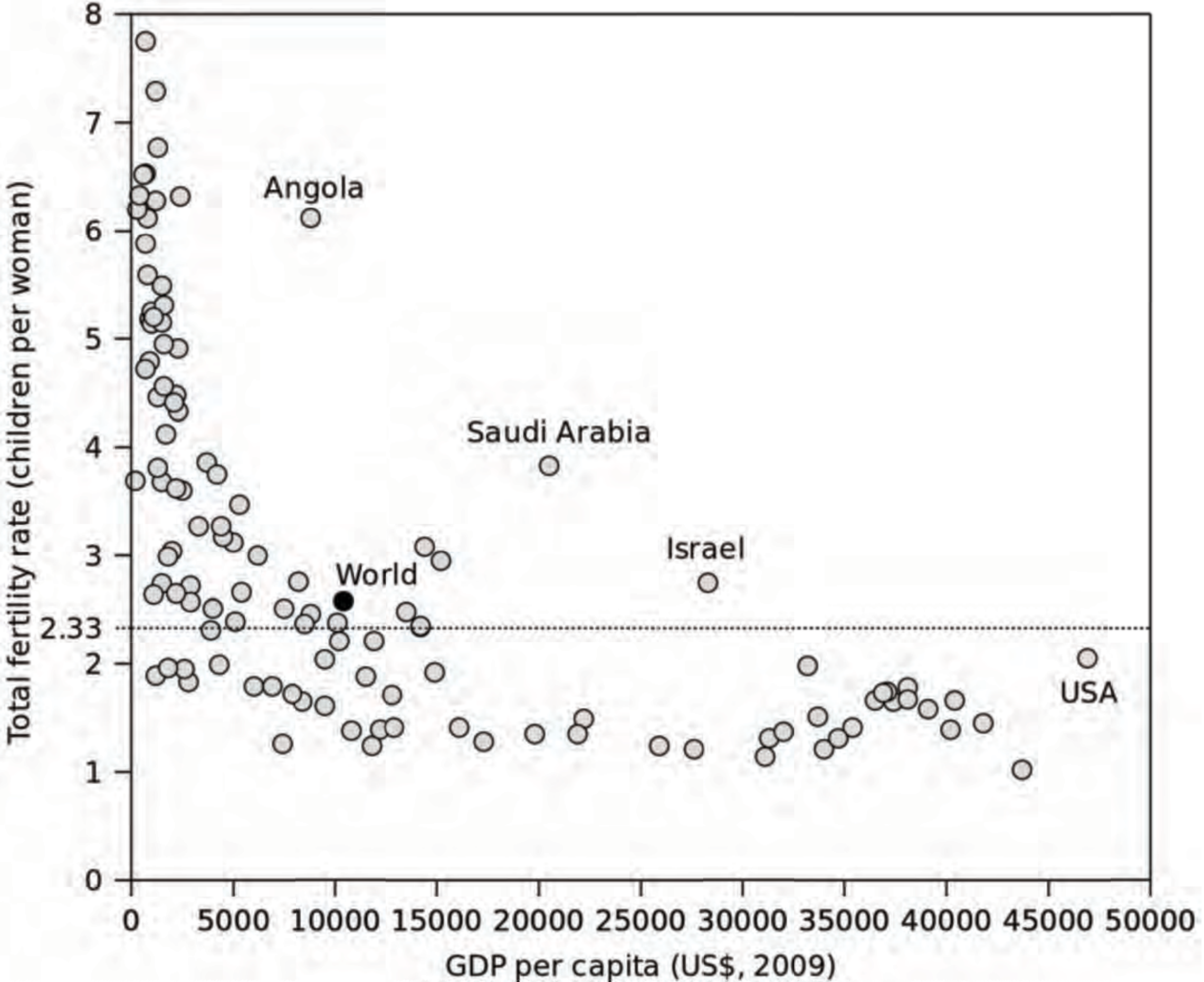
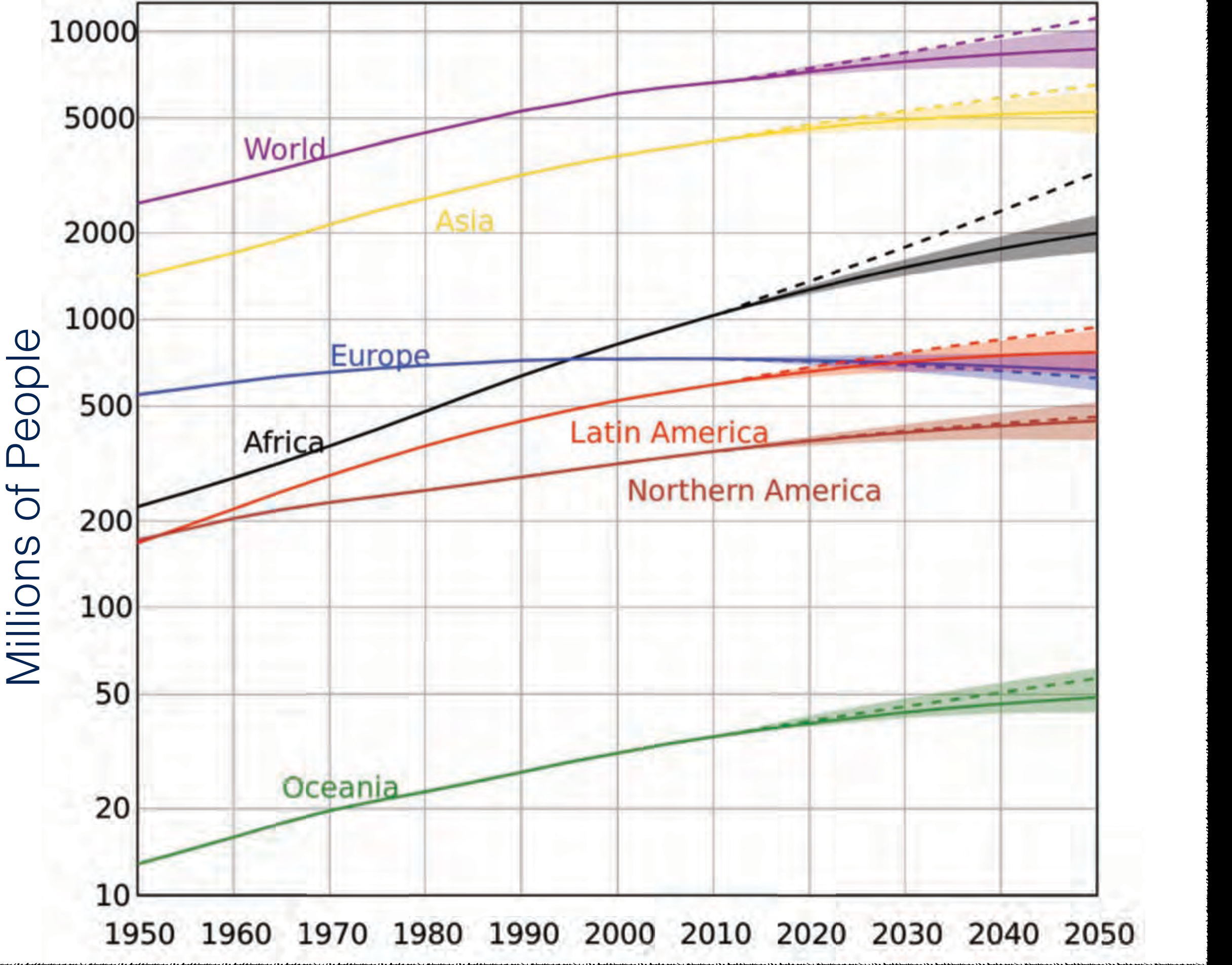
Humanity's Biggest Challenges

- Health, Life Expectancy?
- Food, Water, Energy, Accommodation
- Education, Employment, Stability, Safety


Angola
Saudi Arabia
Israel
World
USA
2.33
Total fertility rate (children per woman)
GDP per capita (US$, 2009)
0
1
2
3
4
5
6
7
8
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000


Millions of People
10000
5000
2000
1000
500
200
100
50
20
10
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
World
Asia
Europe
Africa
Latin America
Northern America
Oceania

Humanity's Biggest Challenges

- Health, Life Expectancy?
- Food, Water, Energy, Accommodation
- Education, Employment, Stability, Safety

To Achieve a level of prosperity across the world
To Stabilise Population of the Earth
To lower drivers of conflict
and to allow the entire world to focus on living sustainably
through advances in science

Humanity's Biggest Challenges

We should not Under-estimate the e□ects of Climate Change

- Changing Weather Patterns will impact agriculture
- Less glacial Run o□ will dramatically change water resources in Asia (as well as parts of Europe and North America)
- Rising Sea levels will impact heavily on low-lying coastal areas

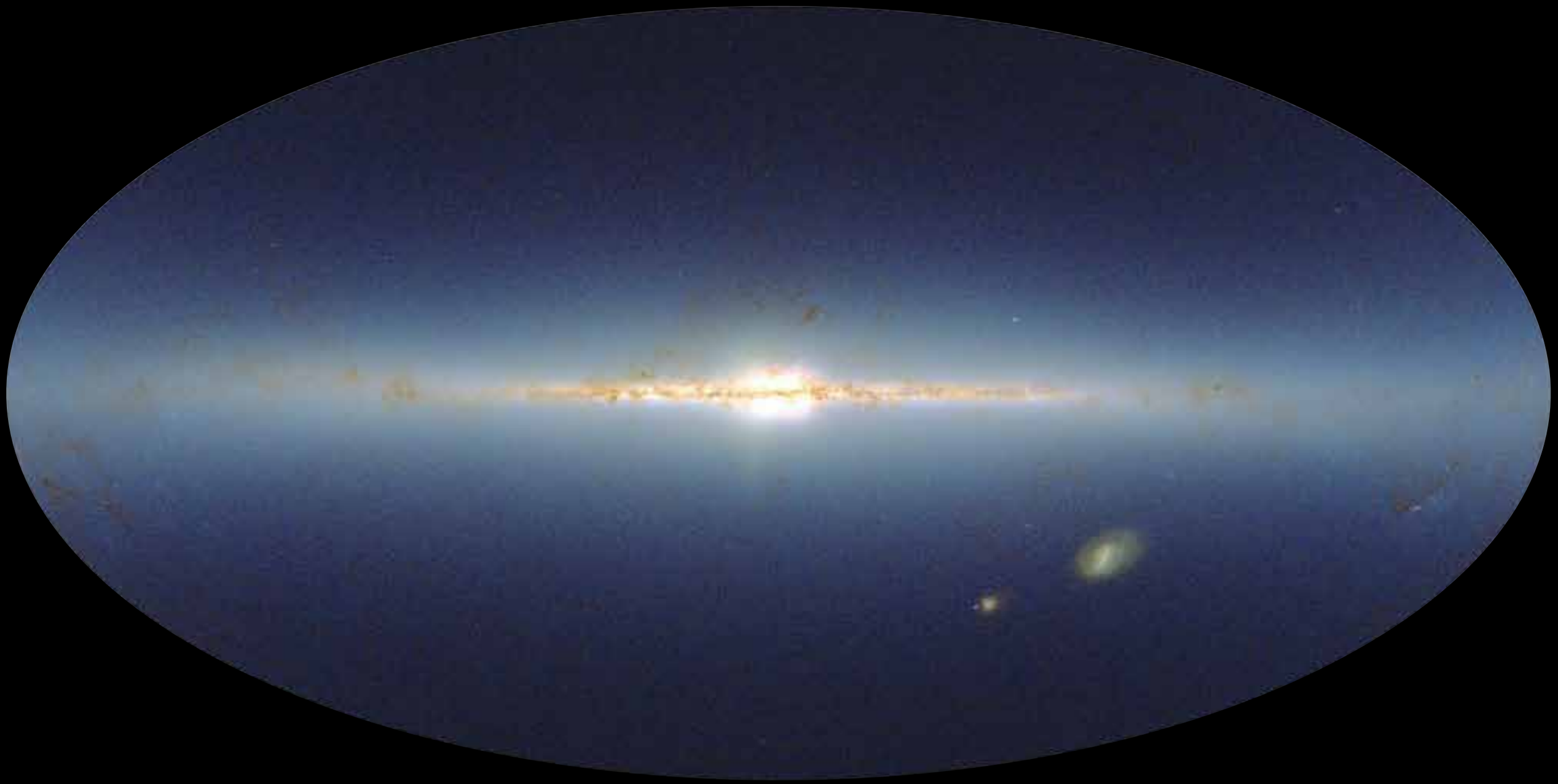
While all these factors can be managed with technology, they also all have the potential to create con□ict over resources.

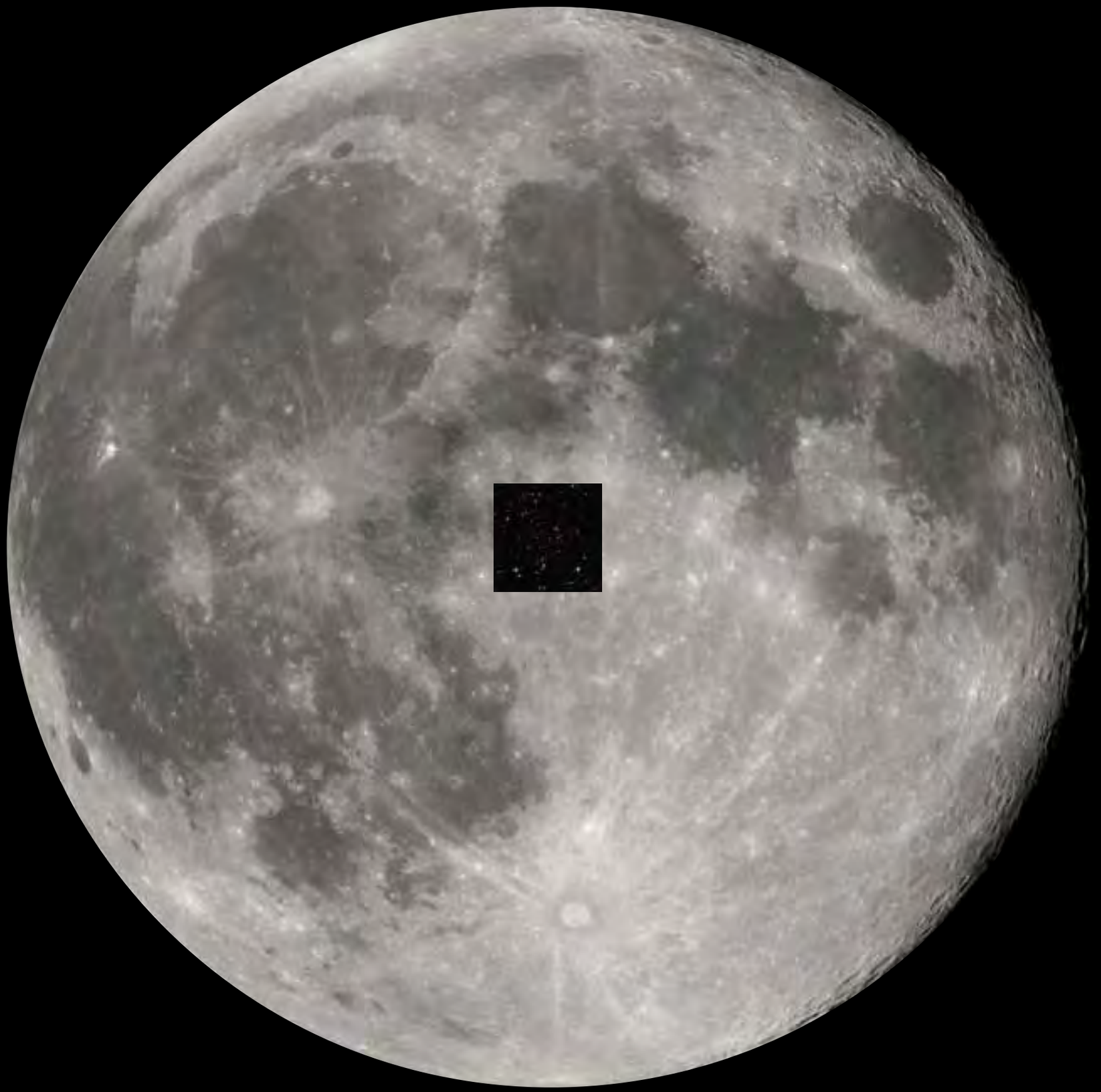
Future Prospects for Humanity

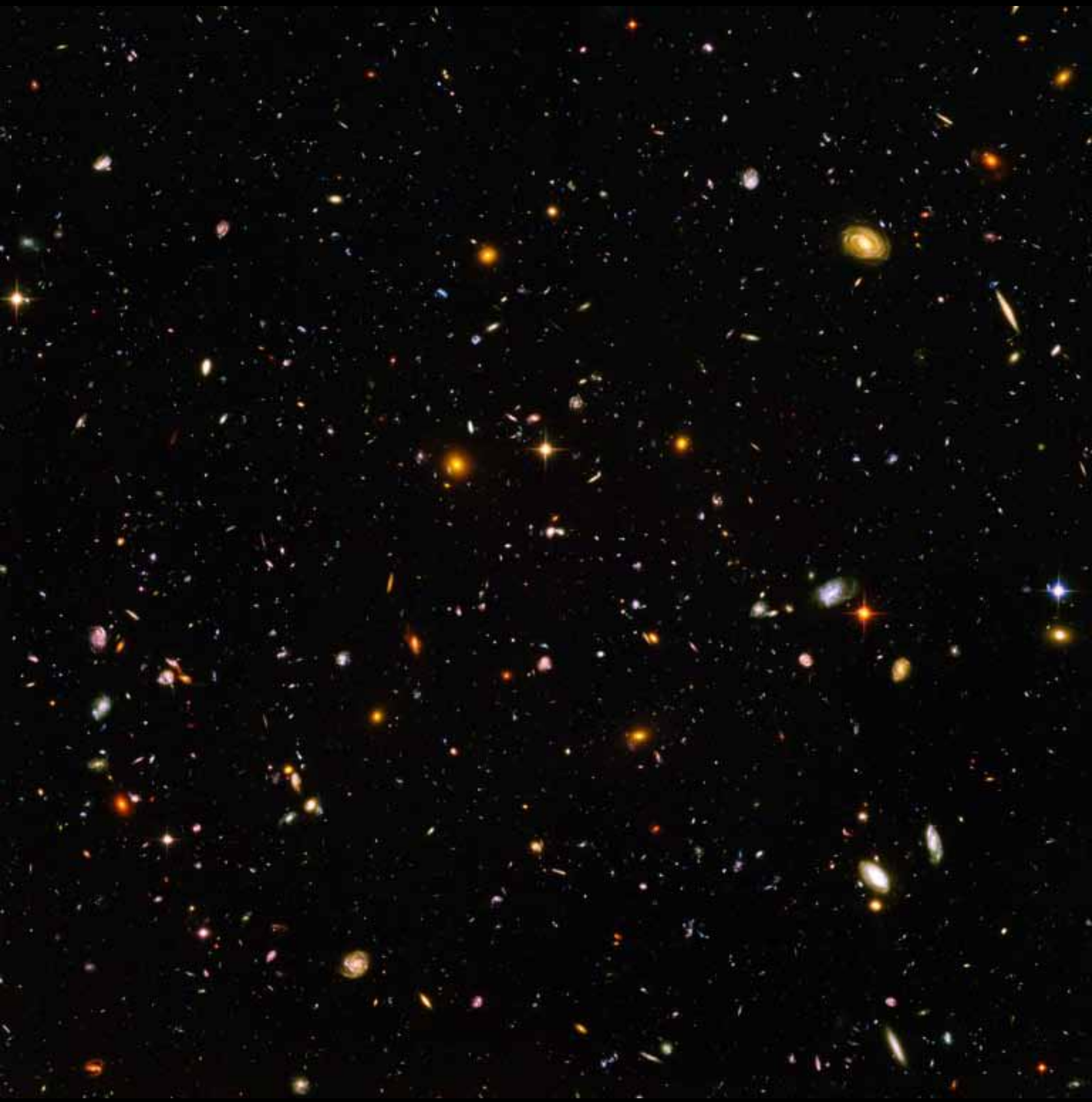
Humans have lived on Earth for less than
100,000 of the Earth's 4.54 Billion Years

What Can Expect for the Future

- Supervolcanic Eruptions (5000 years)
- Ice Ages - Warm Periods (50,000 years)
- Comet and Asteroid Impacts (50 Million Years)
- Sun Overheating Earth (500 Million Years)
- Sun consuming Earth (5 Billion Years)

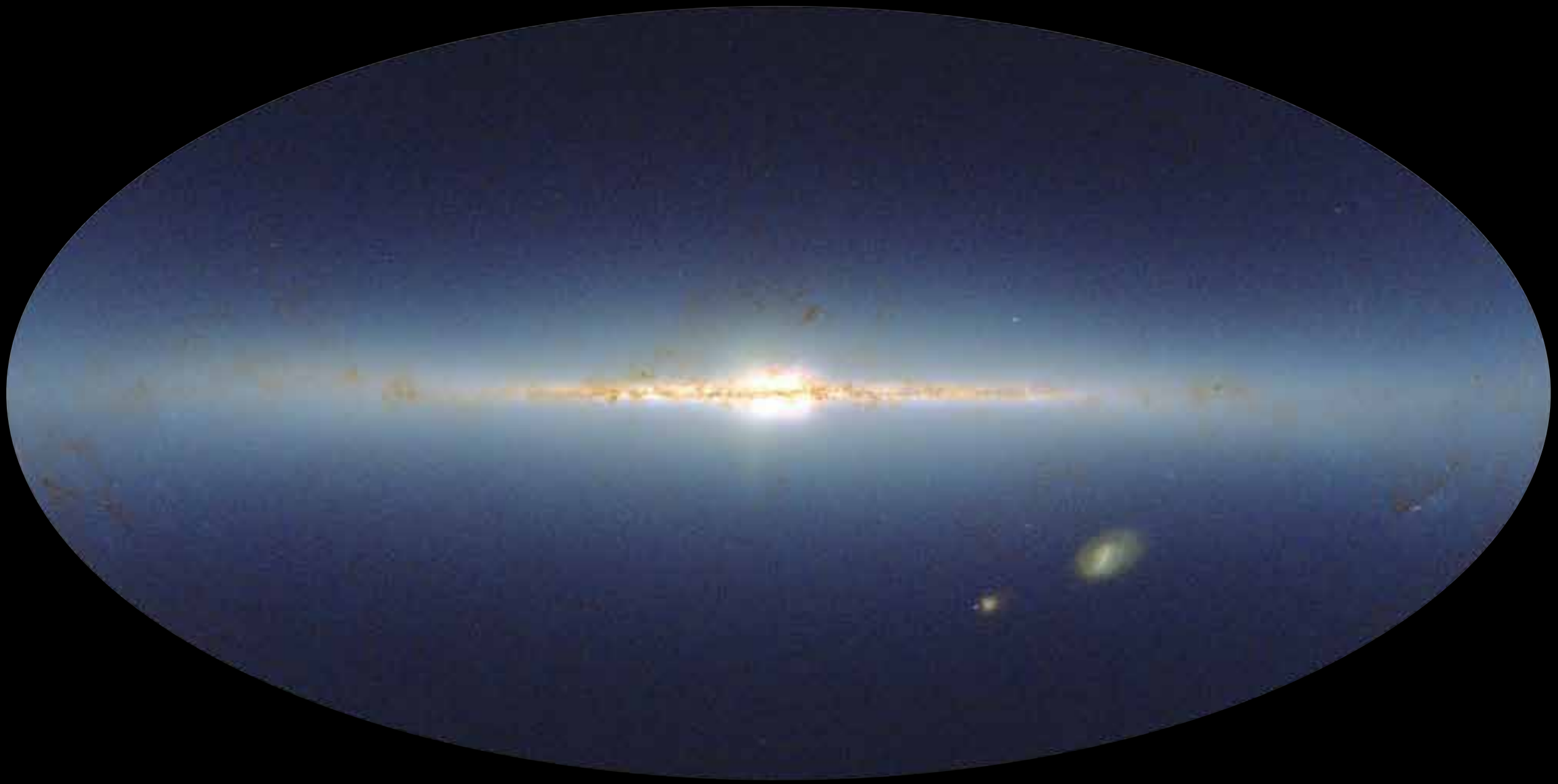




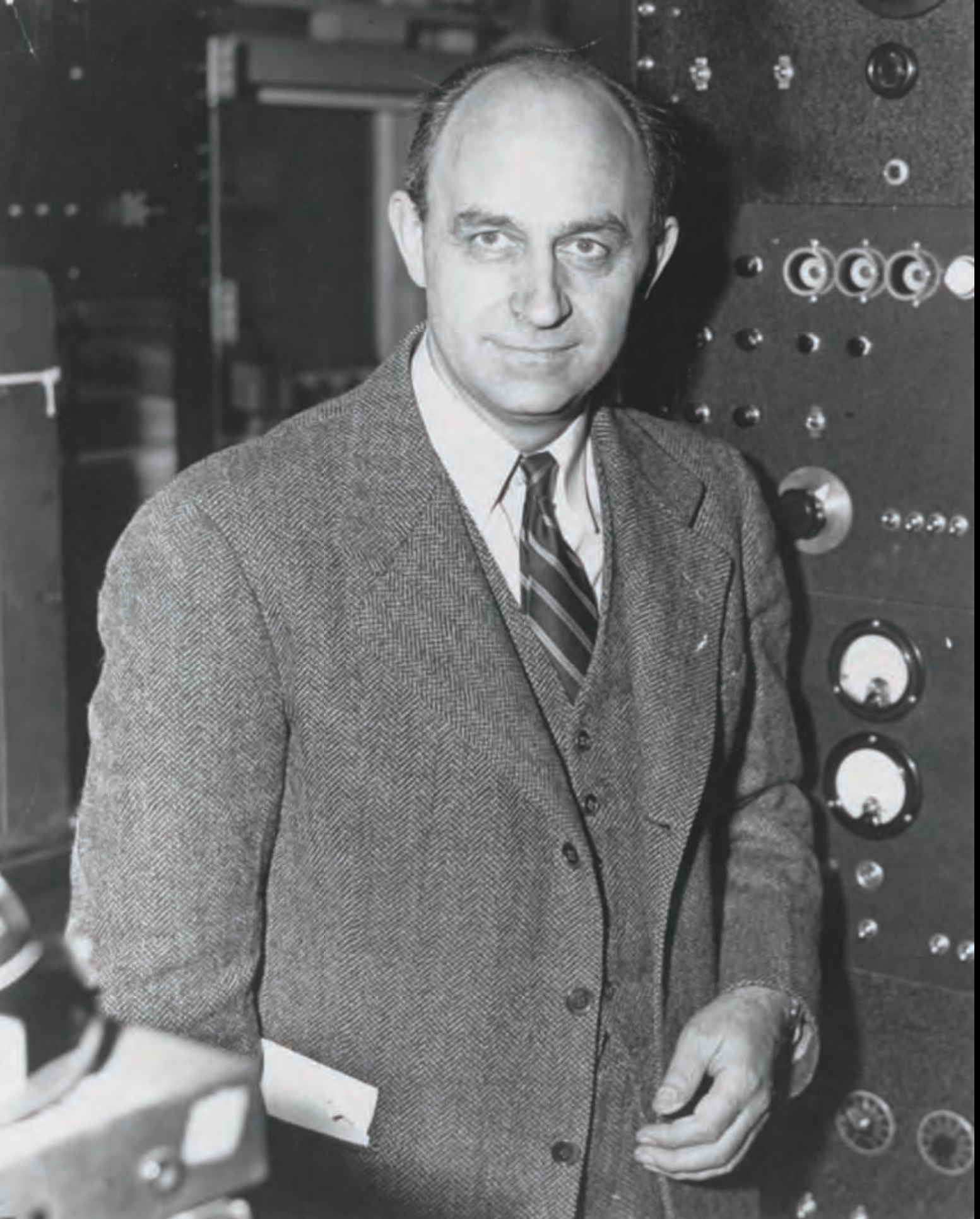


4.3 light years or 26,000 year trip at the speed of the New Horizons space craft

100,000 light years or 0.6 Billion year trip at the speed of the New Horizons space craft



100 Billion Stars - Estimates are 20 Billion of them have habitable planets



Enrico Fermi's Paradox

If in the past 13.8 billion years, any civilisation has mastered interstellar travel…
Then it would have had time to spread across the entire Galaxy…
Yet we see no such civilisation…
Will Humanity be the First?

What Will Be Humanity's Fate?

- We have the power, through Science, to survive and thrive almost no matter what the Universe deals us.
- But we also have the power to destroy ourselves, to not plan for the future, and to become prey to random acts of Mother Nature
- Our Fate Is Largely In Our Own Hands