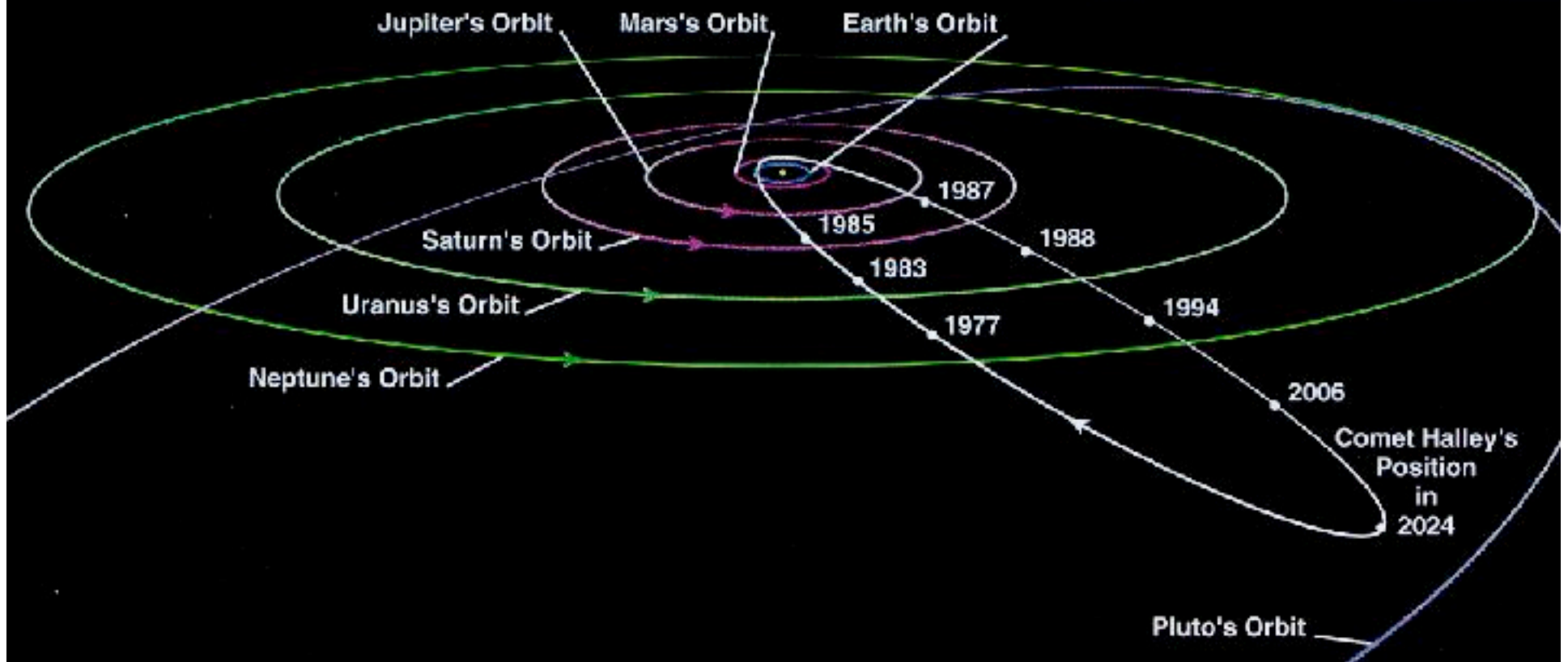
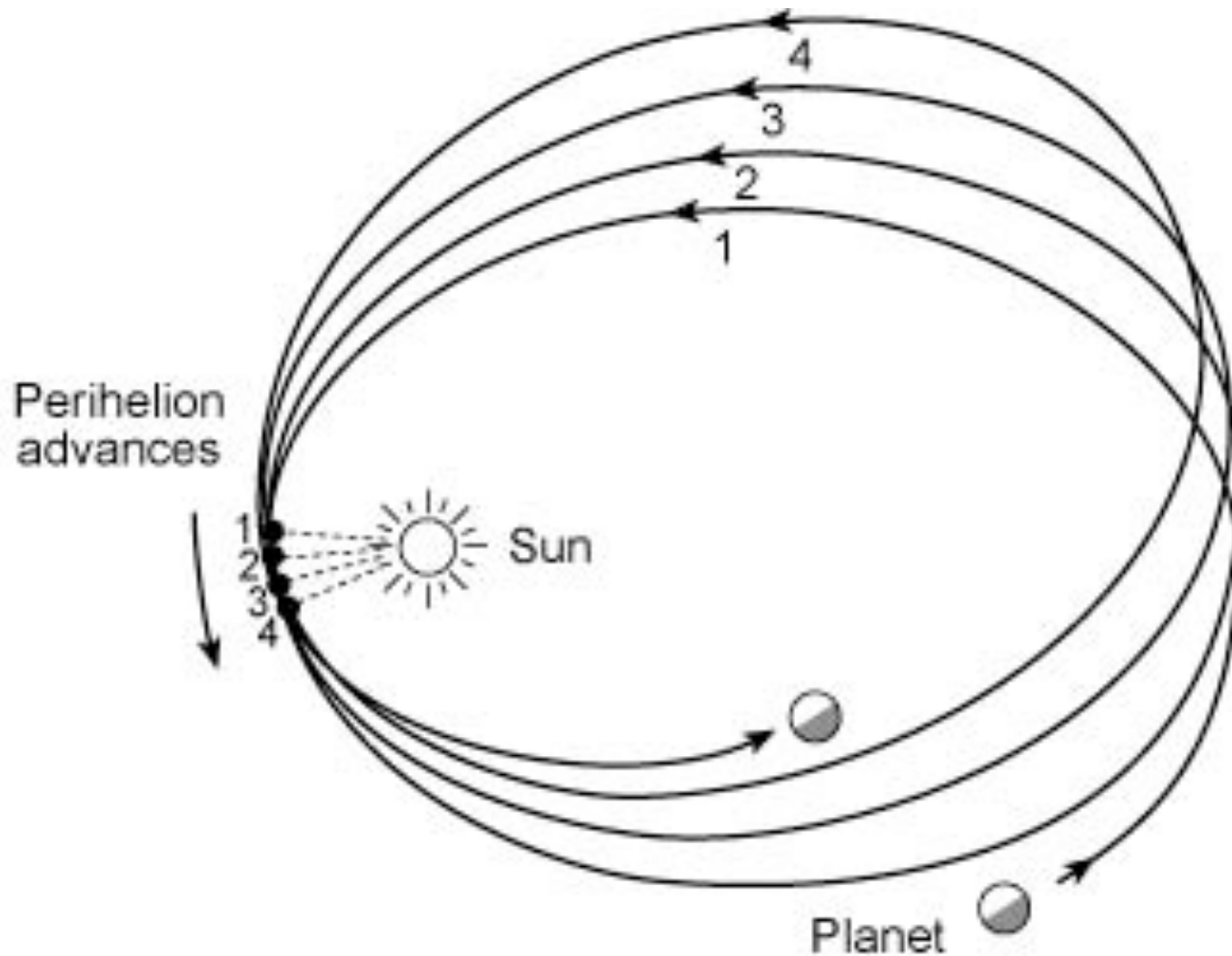


Newton's Theory Predicts Orbits of Planets/Comets



A Problem: Mercury's Orbit Not Perfect

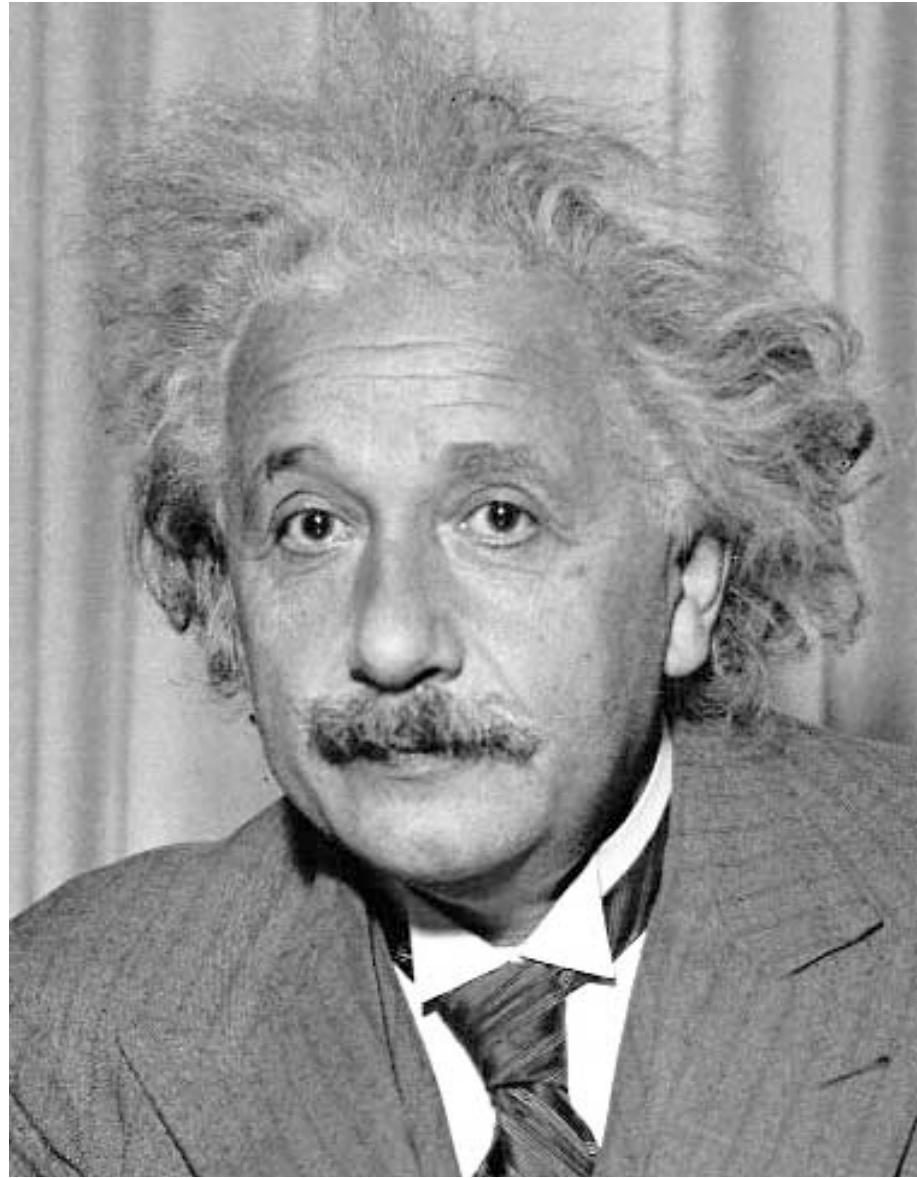
NOT PREDICTED BY NEWTON



Prediction: Another Planet – “Vulcan” – inside Mercury’s Orbit

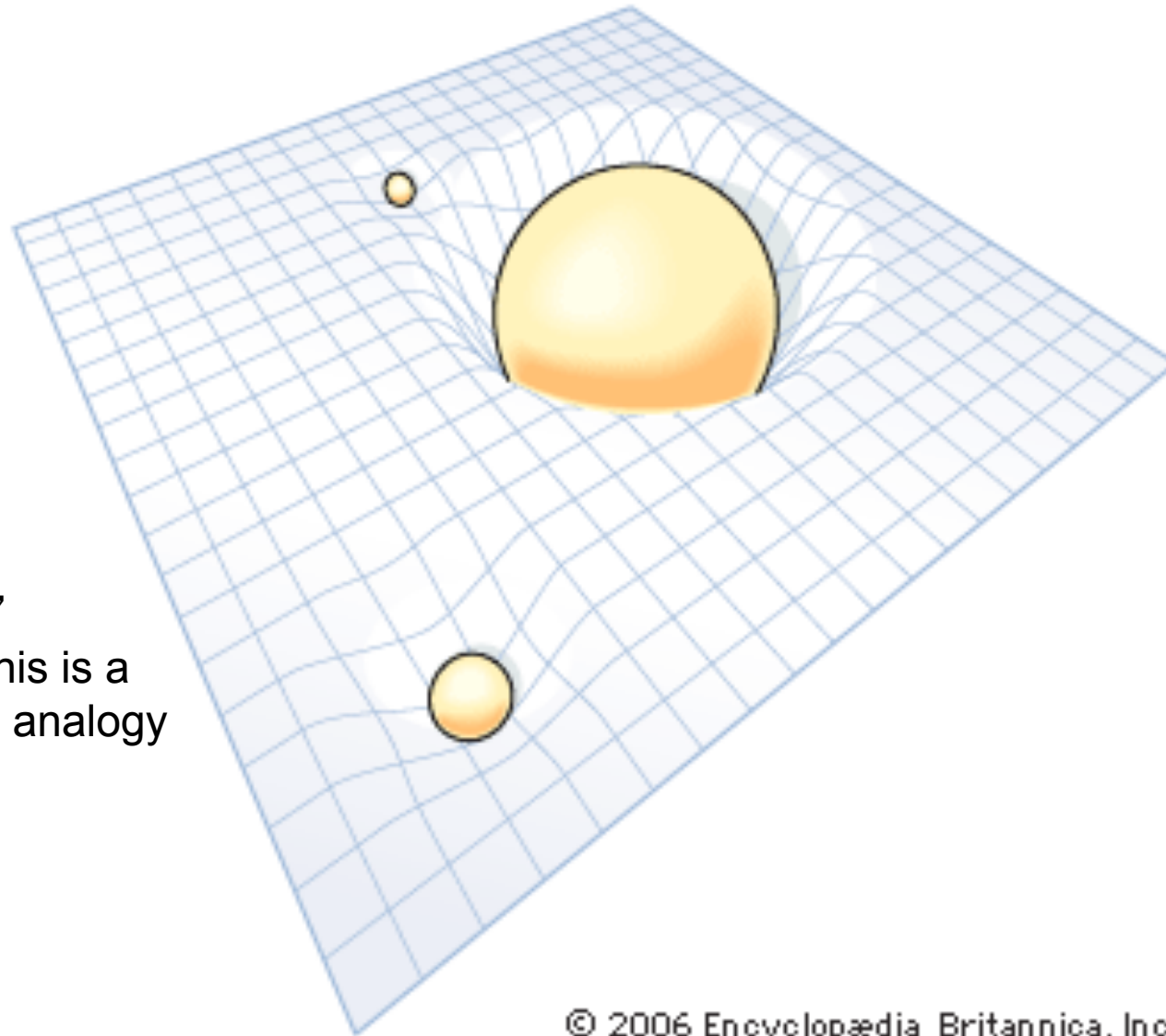


A New Theory of Gravity: General Relativity



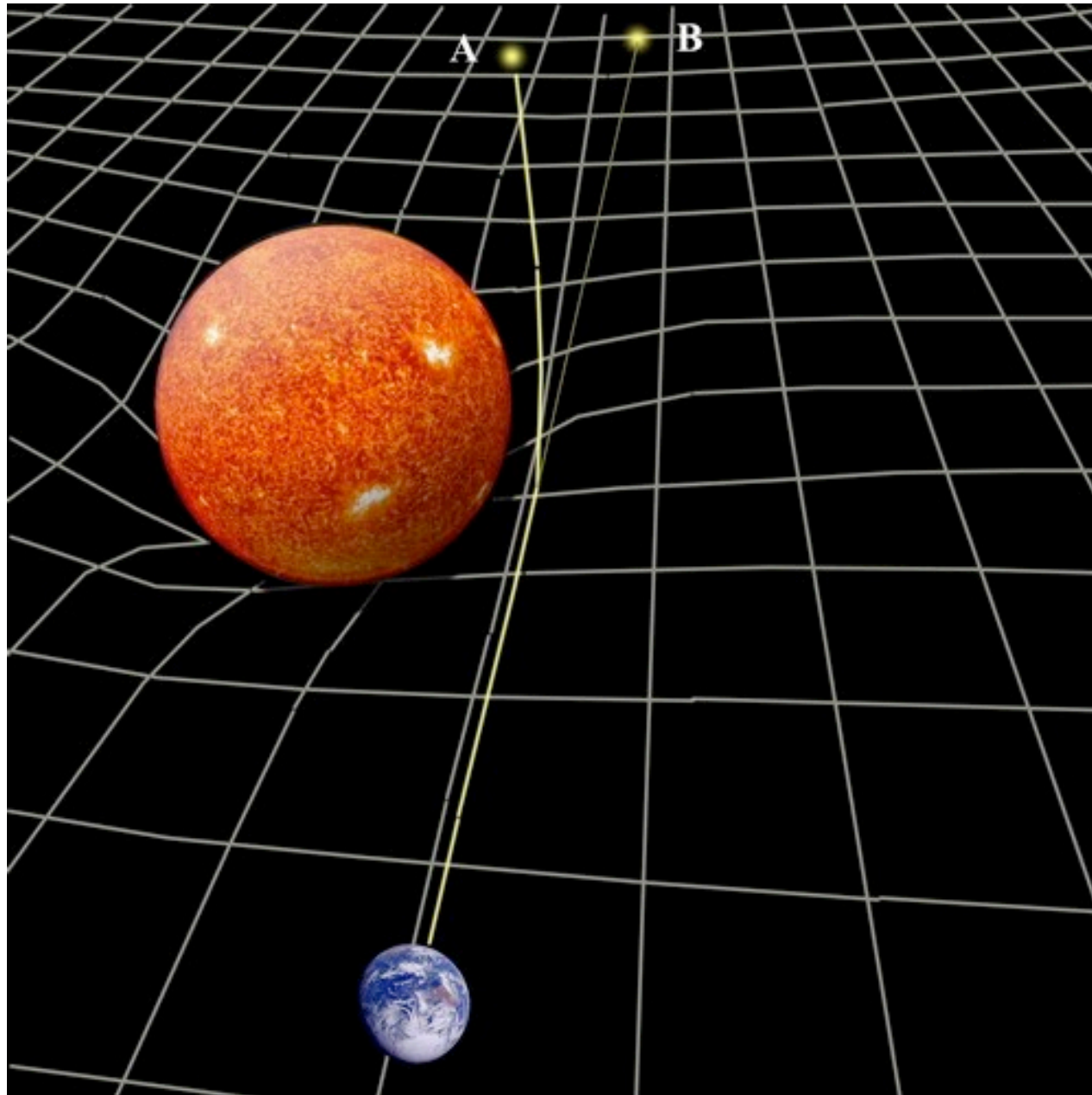
Einstein

A New Theory of Gravity: General Relativity

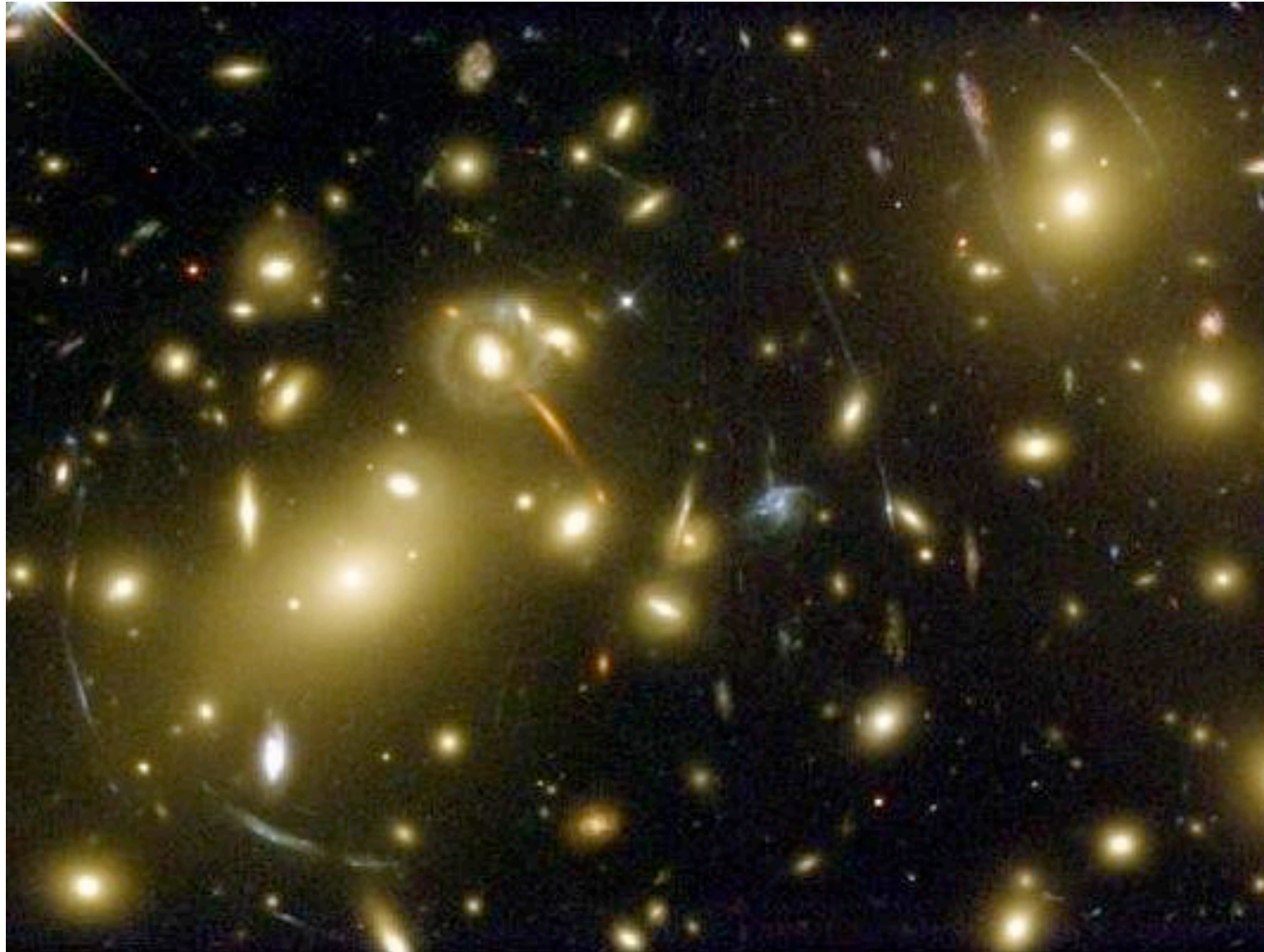


Mass “warps”
spacetime. This is a
2 dimensional analogy

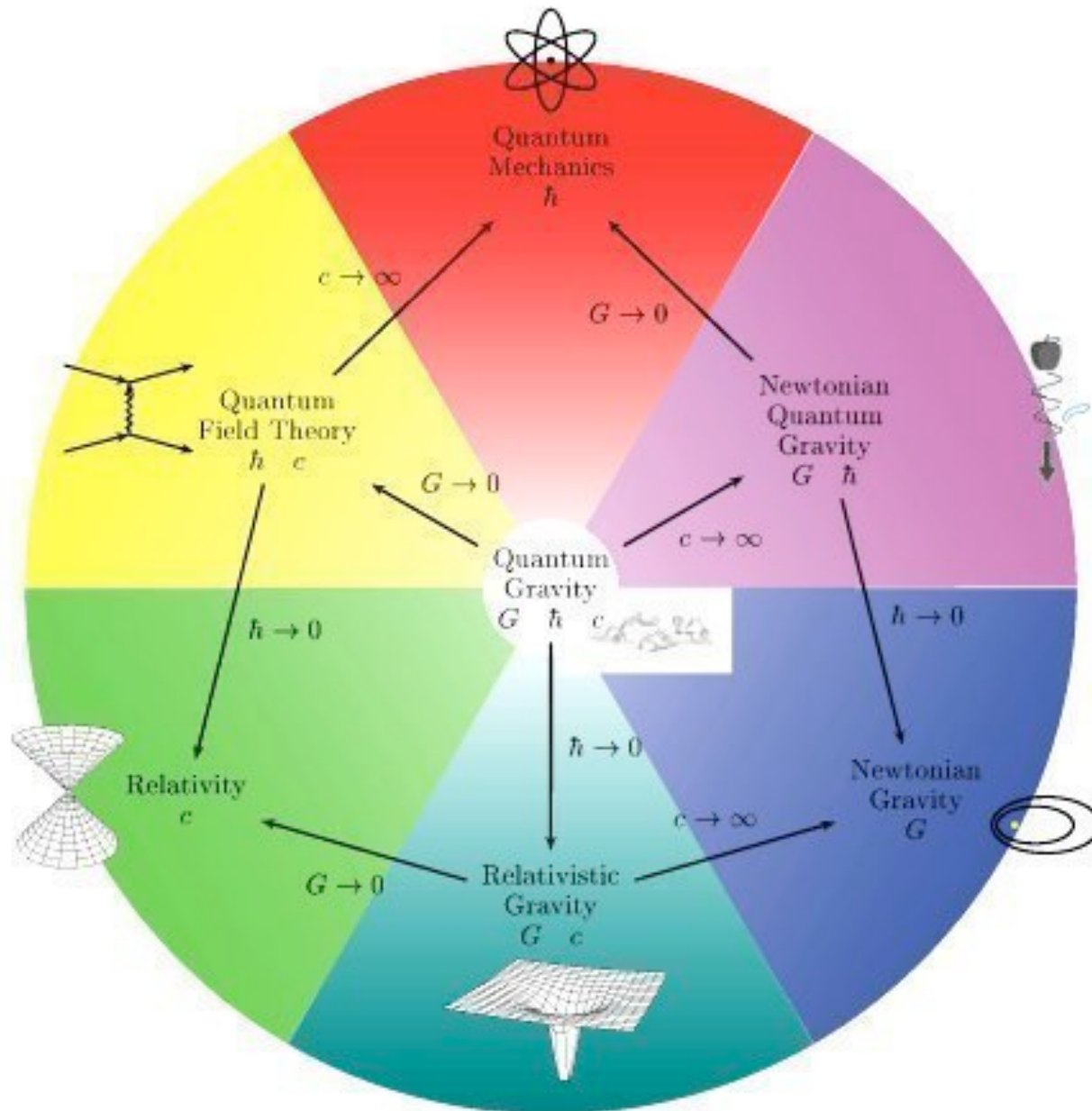
Prediction: Einstein's Theory of Gravity



Evidence for General Relativity : Gravitational Lens



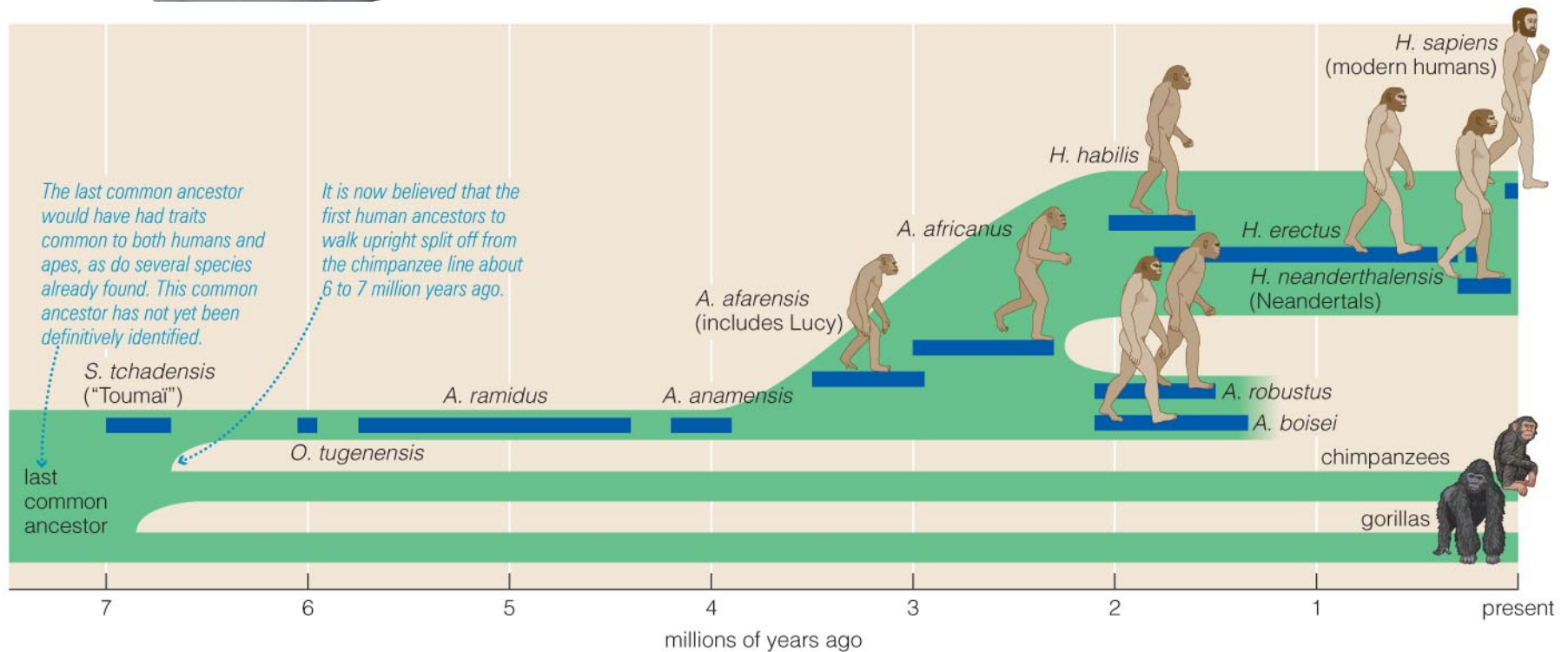
Is General Relativity the final Theory of Gravity?

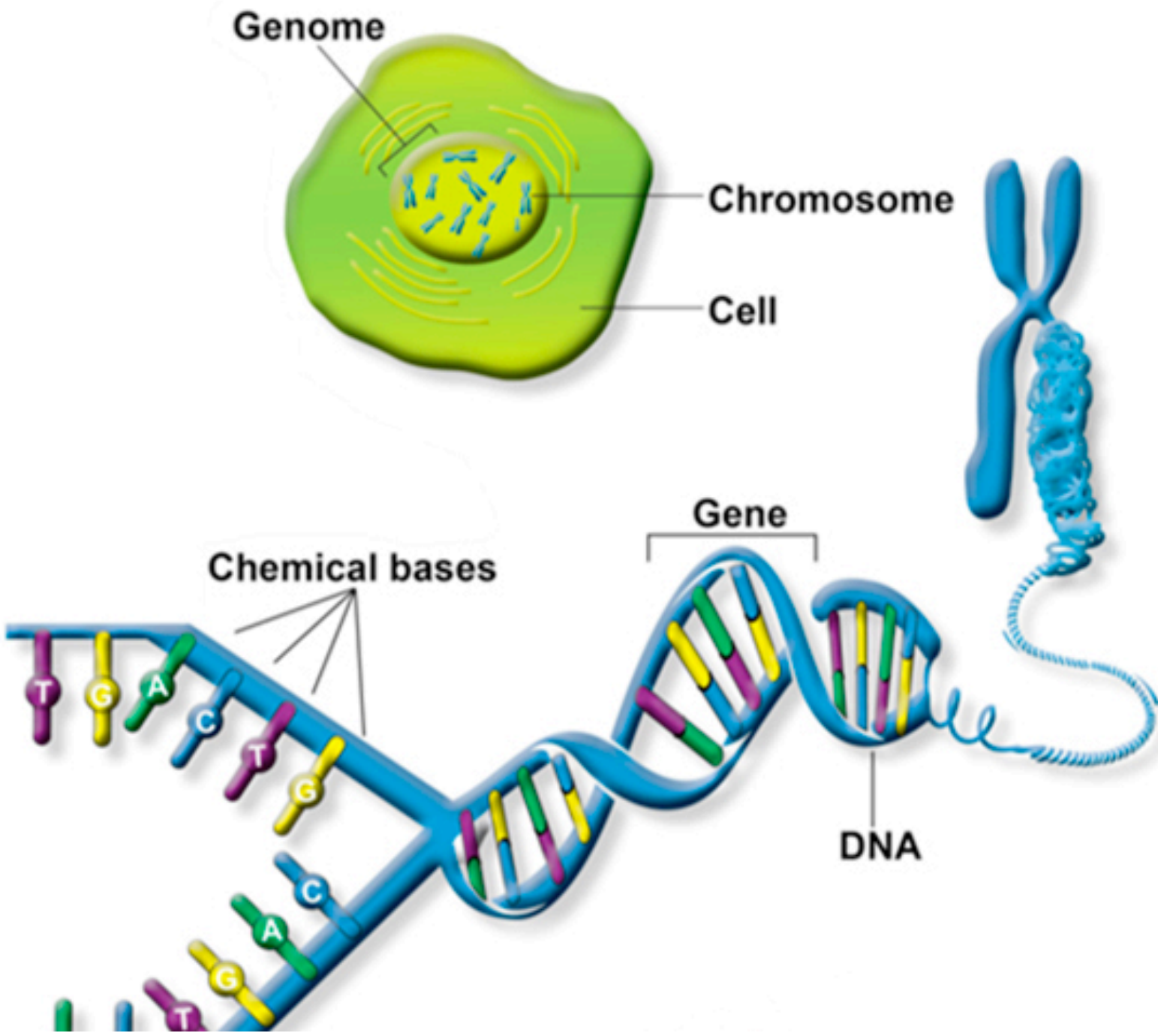


A Second Example of a Scientific Theory : Evolution



Modern Humans and other primates (i.e. Chimpanzees and Gorillas) evolved from a common ancestor several million years ago.



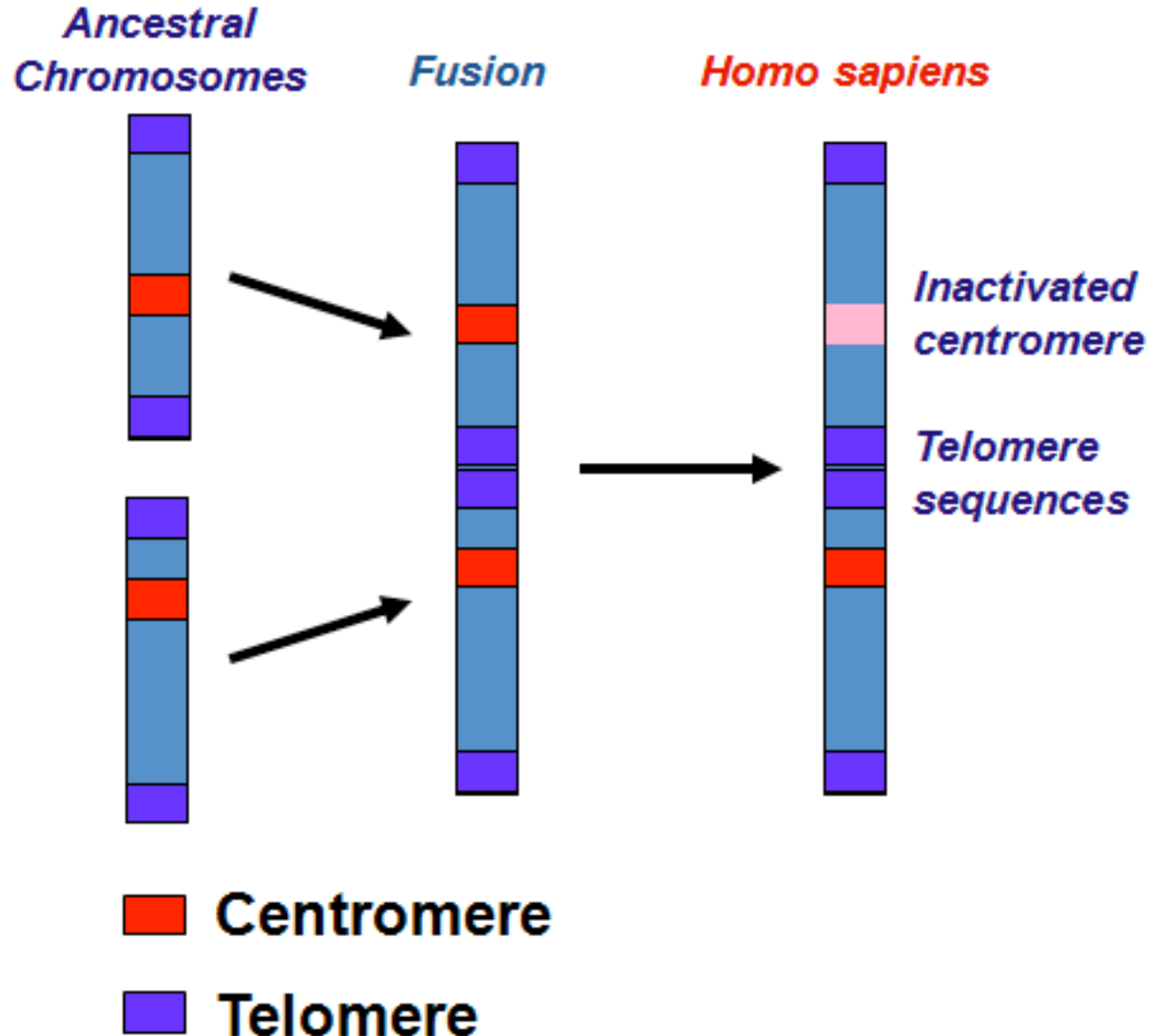


Genetic Evidence for Human Evolution: Human Chromosome 2



Other primates have 24 pairs of chromosomes but Humans only have 23. How can we be genetically related?

The answer: Human chromosome 2 is a fusion of two chromosomes from a common ancestor



Pseudoscience Example of Astrology

The ancient belief that the Sun, Moon, and the planets affect human behavior and personality

Astrology is NOT the same as Astronomy









Astrology

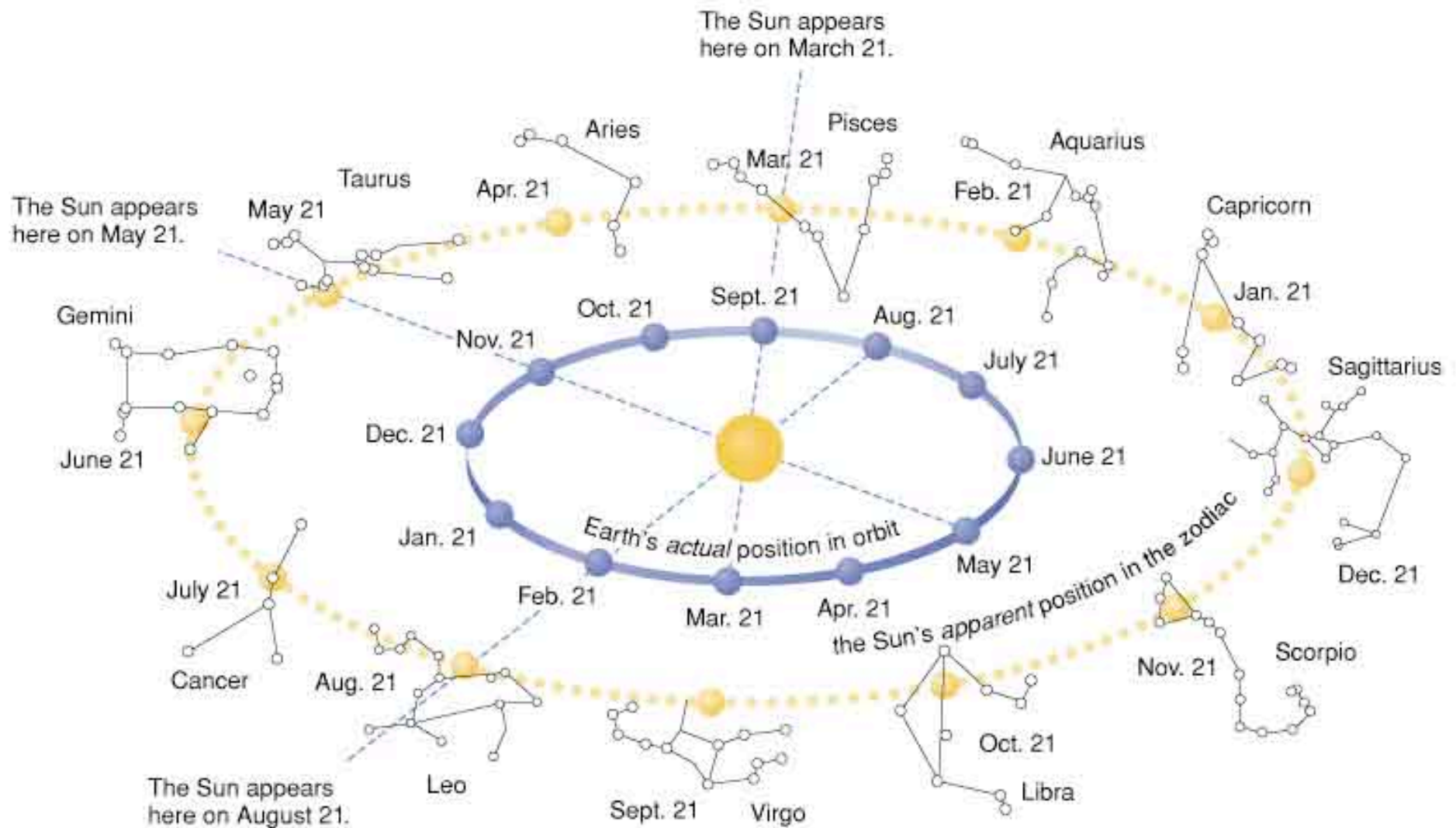
- Claims to study how the positions of the Sun, Moon, & planets among the stars influence human behavior
- Started by Babylonians 1000 BC, was a driving force which advanced ancient astronomy
- Kepler & Galileo were the last astronomers to cast horoscopes... since then astronomy grew apart from astrology into a modern science
- All modern scientific tests of astrology fail... it is a *pseudoscience*

Astrology (cont)

- Is a **\$200M** per year business, in at least 1000 newspapers, with **10,000** practicing astrologers
- Uses astronomical information, but has critical and subjective step of interpretation
- Has failed many published statistical tests with samples of thousands of people
- Failed a famous test by Gauquelin, who found no match of star signs and profession. He also gave a free horoscope to hundreds, 95% said it fit them, but it was France's famous murderer

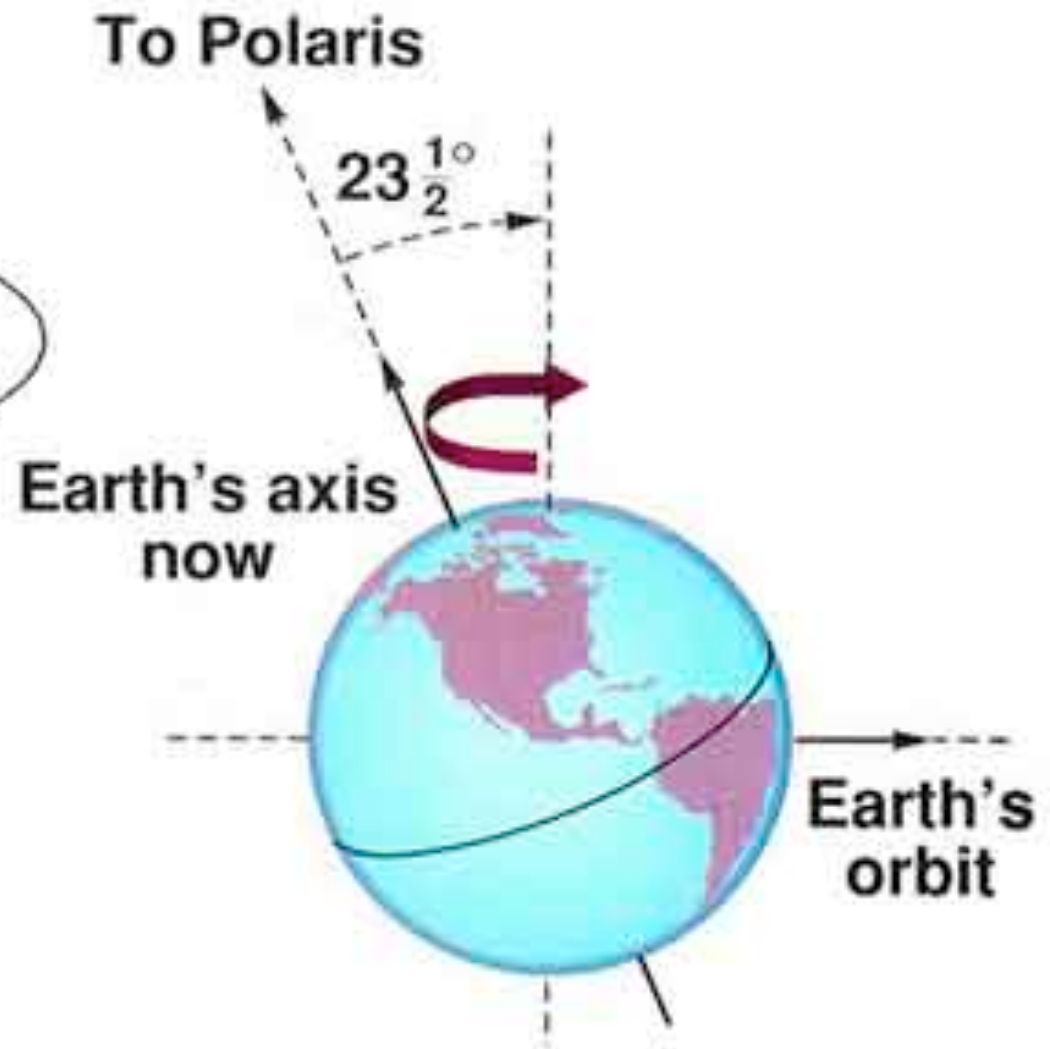
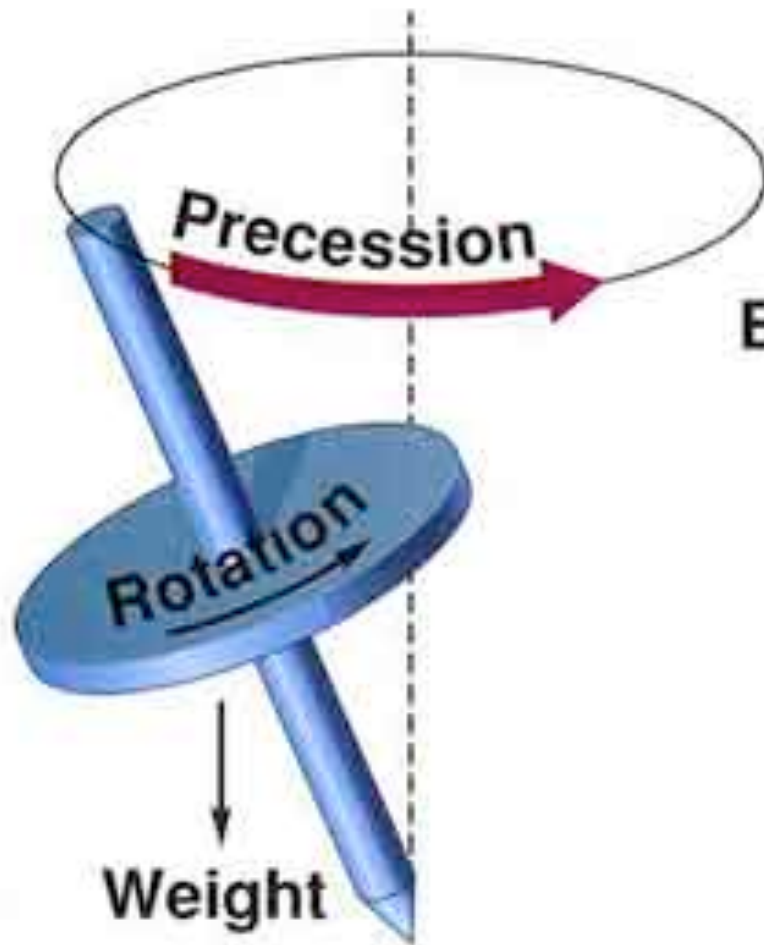
DATES:	ZODIAC SIGN:		ELEMENT:
21 January - 19 February		AQUARIUS	AIR
20 February - 20 March		PISCES	WATER
21 March - 20 April		ARIES	FIRE
21 April - 21 May		TAURUS	EARTH
22 May - 21 June		GEMINI	AIR
22 June - 22 July		CANCER	WATER
23 July - 23 August		LEO	FIRE
24 August - 23 September		VIRGO	EARTH
24 September - 23 October		LIBRA	AIR
24 October - 22 November		SCORPIO	WATER
23 November - 21 December		SAGITTARIUS	FIRE
22 December - 20 January		CAPRICORN	EARTH

Zodiac Constellations



Precession of Earth's Axis

~26,000 years to go around



WHAT'S YOUR 'REAL' HOROSCOPE?

Capricorn: January 20 - February 16

Aquarius: February 16 - March 11

Pisces: March 11 - April 18

Aries: April 18 - May 13

Taurus: May 13 - June 21

Gemini: June 21 - July 20

Cancer: July 20 - August 10

Leo: August 10 - September 16

Virgo: September 16 - October 30

Libra: October 30 - November 23

Scorpio: November 23 - 29

Ophiuchus: November 29 - Dec 17

Sagittarius: Dec 17 - January 20



Not Scientific Practice

- **pseudoscience** – it masquerades as science, but it does not follow the scientific rules of evidence.
- **nonscience** – establishes “truths” through beliefs which are not subject to doubt or rebuttal or verification.
- **sortascience** – any legal system or type of advertising where there is selective use of evidence to argue a particular point of view, with “winners” and “losers.”

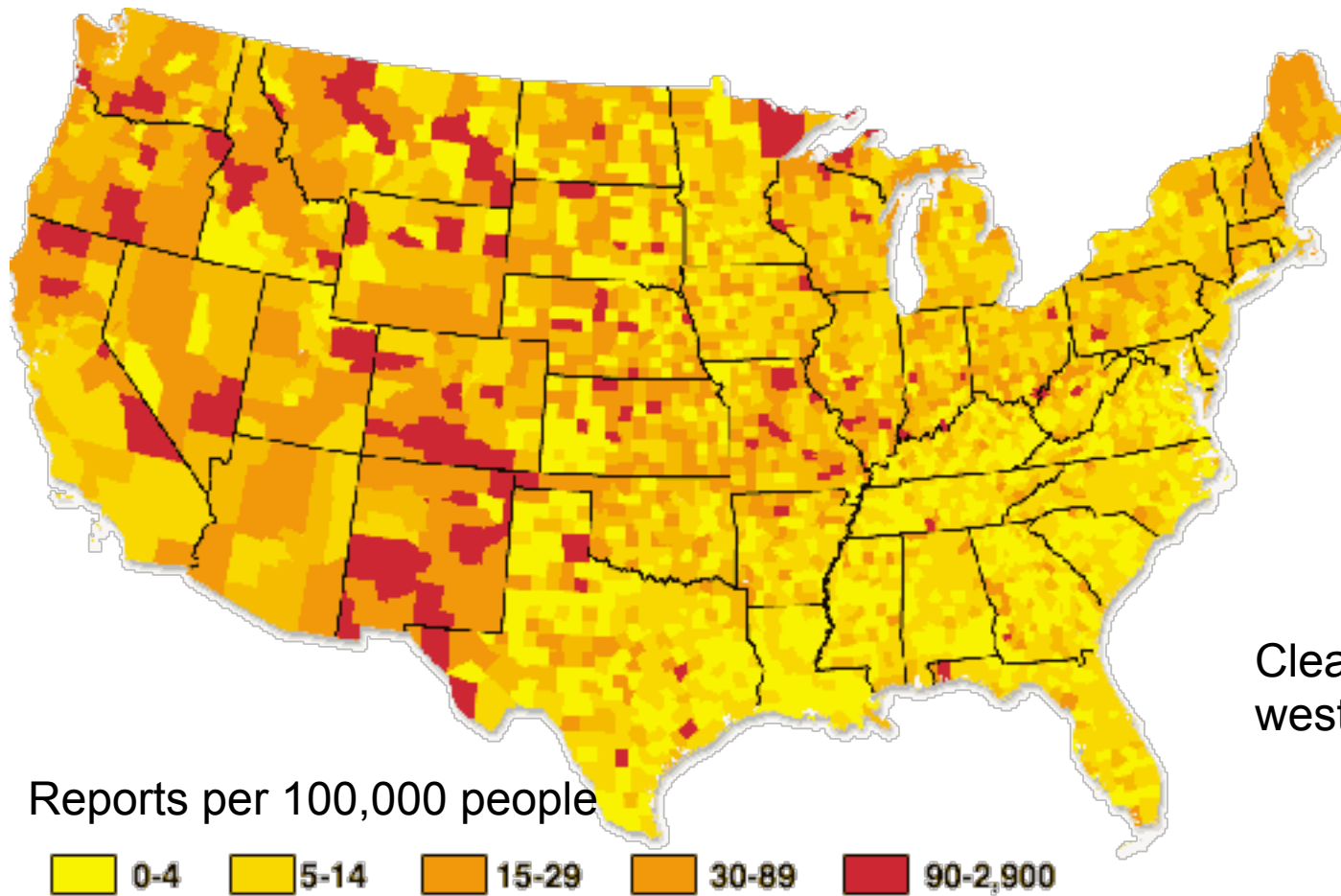
Examples of Pseudoscience

- **ESP** – not subject to testing or verification, the confirmation bias is very strong.

Examples of Pseudoscience

- **ESP** – not subject to testing or verification, the confirmation bias is very strong.
- **UFOs** – most sightings are Venus, where is the physical evidence (conspiracy theory).

Are Aliens Visiting Us ?



Possible...

But a vast majority of UFOs are easily and normally explained; standard of evidence is very high.

Clearly – Aliens prefer the western U.S...



Coining the term “Flying Saucer”

A classic misquote by newspaper media (from *Demon Haunted World* by Carl Sagan):

There was something odd about the very invention of the phrase “flying saucer.” As I write this chapter, I have before me a transcript of an April 7, 1950 interview between Edward R. Murrow, the celebrated CBS newsman, and Kenneth Arnold, a civilian pilot who saw something peculiar near Mount Rainier in the state of Washington on June 24, 1947 and who in a way coined the phrase. Arnold claims that the newspapers

did not quote me properly. . . . When I told the press they misquoted me, and in the excitement of it all, one newspaper and another one got it so ensnarled up that nobody knew just exactly what they were talking about. . . . These objects more or less fluttered like they were, oh, I’d say, boats on very rough water. . . . And when I described how they flew, I said that they flew like they take a saucer and throw it across the water. Most of the newspapers misunderstood and misquoted that, too. They said that I said that they were saucer-like; I said that they flew in a saucer-like fashion.

Roswell, New Mexico July 1947

Roswell Daily Record

RECORD PHONES
Business Office 2288
News Department
2287

ROSWELL, NEW MEXICO, TUESDAY, JULY 8, 1947

14 PER COPY.



Claims Army Is Stacking Courts Martial

Indiana Senator
Lays Protest
Before Patterson

RAAF Captures Flying Saucer On Ranch in Roswell Region

Passes h by argin endment to Remove

Security Council Paves Way to Talks On Arms Reductions

Lake Success, July 8 (AP)—The United Nations security council today approved an American proposal for arms reduction discussions despite a Russian warning that the plan would bring about

No Details of Flying Disk Are Revealed

Roswell Hardware
Man and Wife
Report Disk Seen

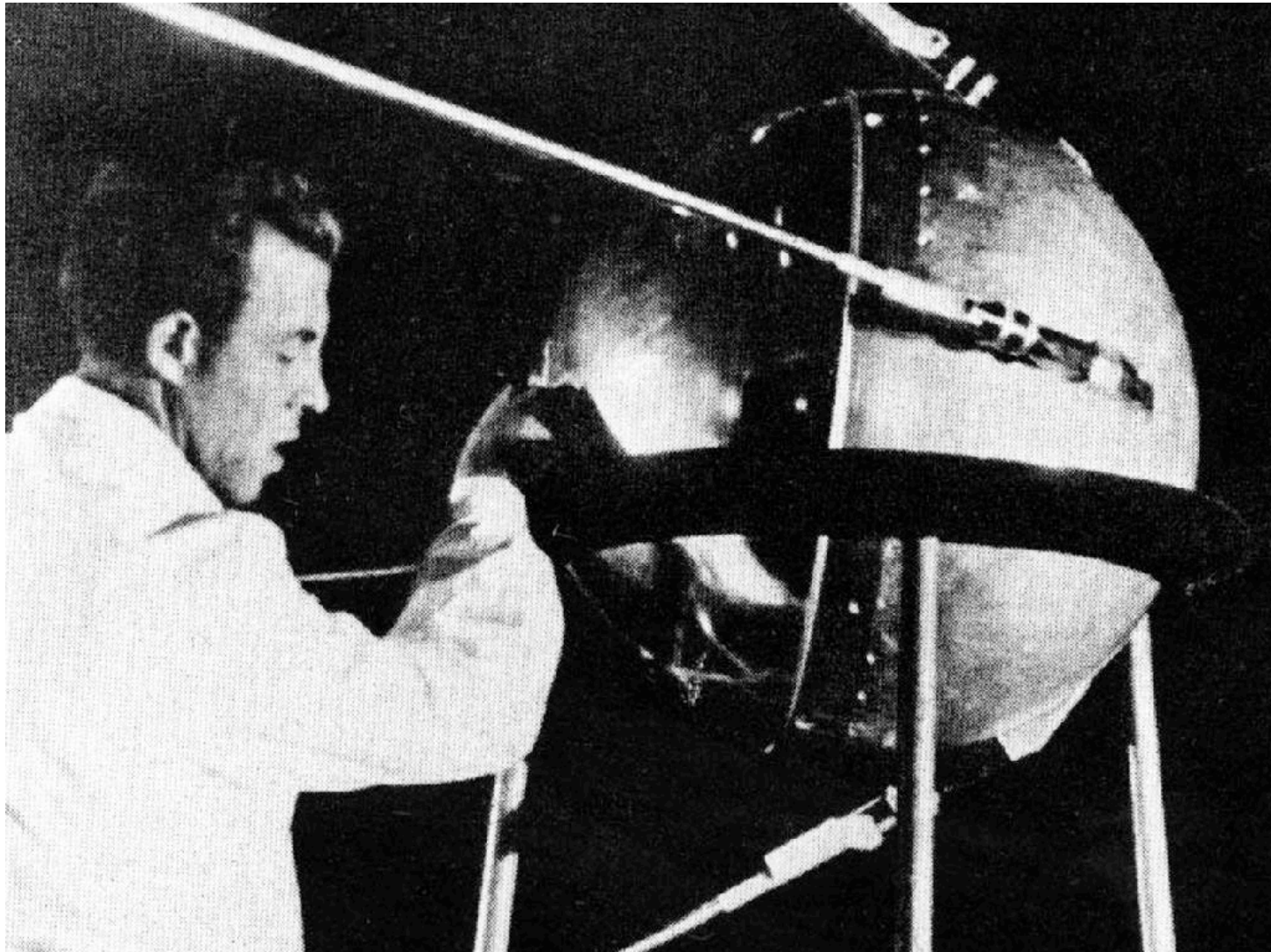
Ex-King Carol Weds Mme. Lupescu



The Roswell debris is from a balloon crash as part of "Project Mogul". Balloons were flown with radar targets and low frequency microphones in an attempt to detect sound waves from nuclear explosions in the USSR. One of the project scientists, Charles Moore is shown holding up one of the radar targets on the left.

Sputnik Launch Oct 4 1957

Of the 1178 UFO sightings reported in the U.S. that year, 701, or 60% - rather than the 25% you'd expect were reported between Oct and Dec (the 1/4th of the year)



The Phoenix Lights 1997





**I WANT TO
BELIEVE**

Examples of Pseudoscience

- **ESP** – not subject to testing or verification, the confirmation bias is very strong.
- **UFOs** – most sightings are Venus, where is the physical evidence (conspiracy theory).
- **Crop Circles** – a proven hoax.

Crop Circles:

They are a
known prank.



Examples of Pseudoscience

- **ESP** – not subject to testing or verification, the confirmation bias is very strong.
- **UFOs** – most sightings are Venus, where is the physical evidence (conspiracy theory).
- **Crop Circles** – a proven hoax.
- **Ancient Astronauts** – usually based on underestimating the sophistication of ancient cultures, or misinterpreting the evidence.

Does it Matter?

YES!

Some superstitions may be harmless but generally, belief in pseudoscience undermines critical thinking. *(it's like a fog bank inside your brain).*

Fuzzy thinking leaves you open to con men, tricksters, and charlatans. Critical issues like global warming or genetic engineering can't be figured out without using logic, data and rational thinking.

