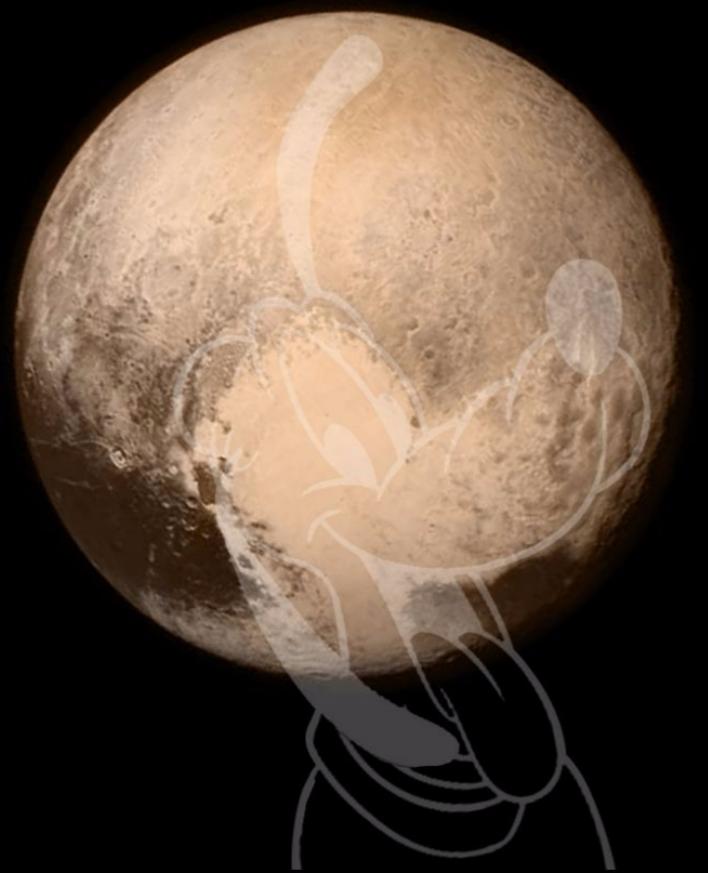
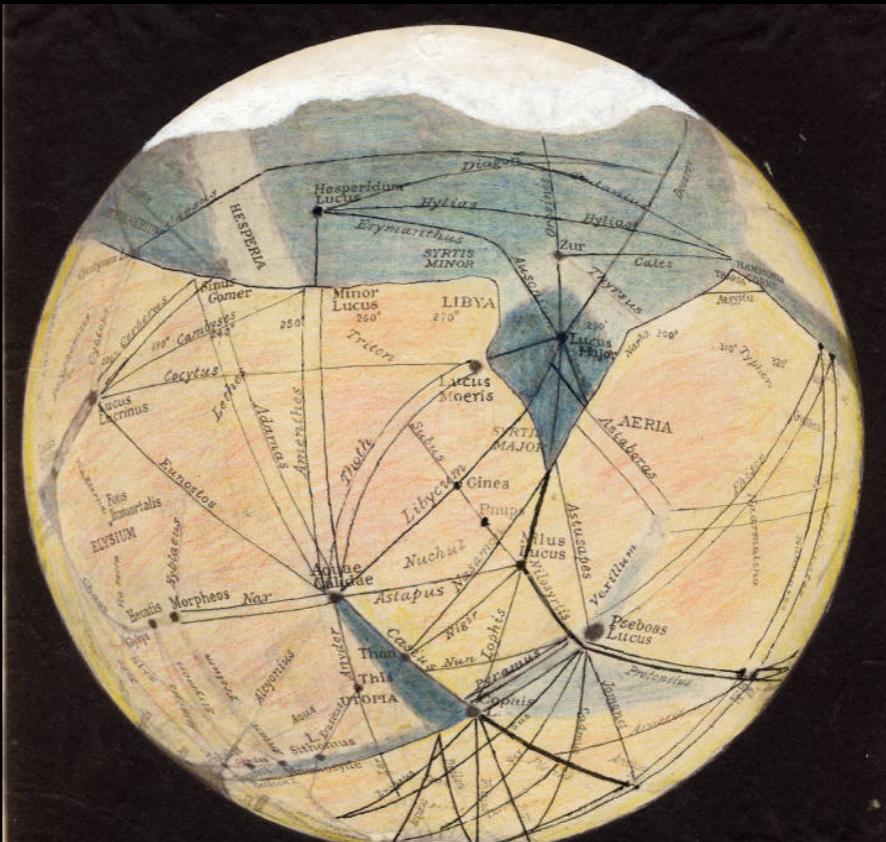


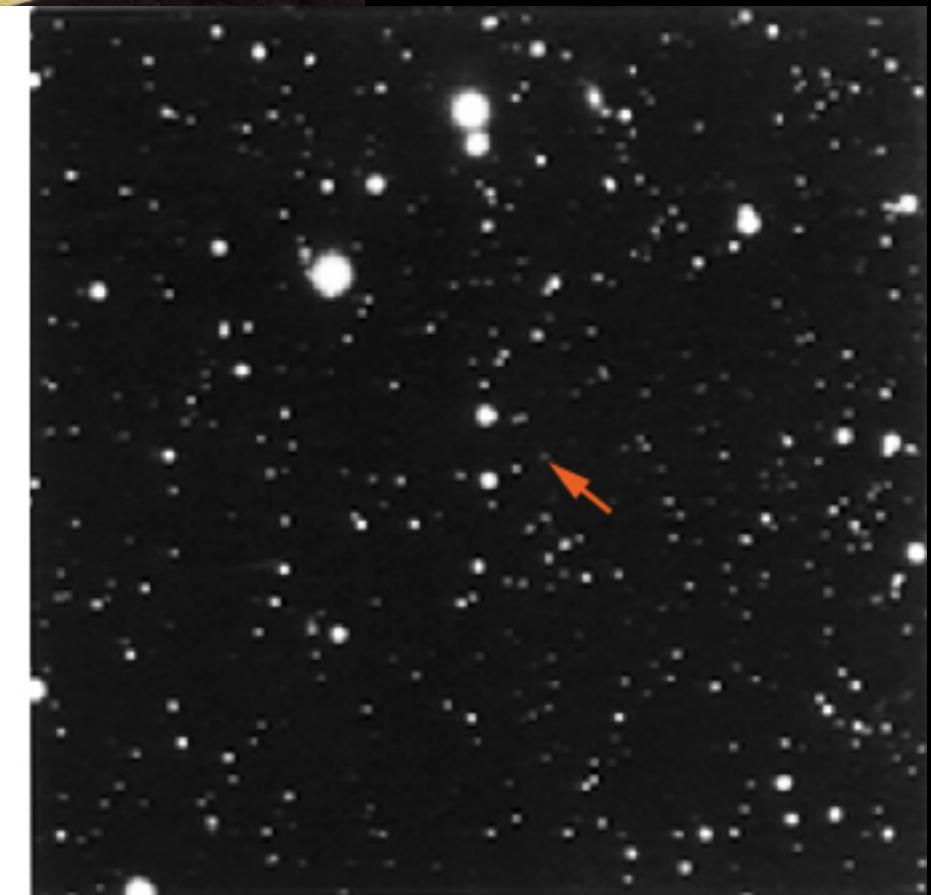
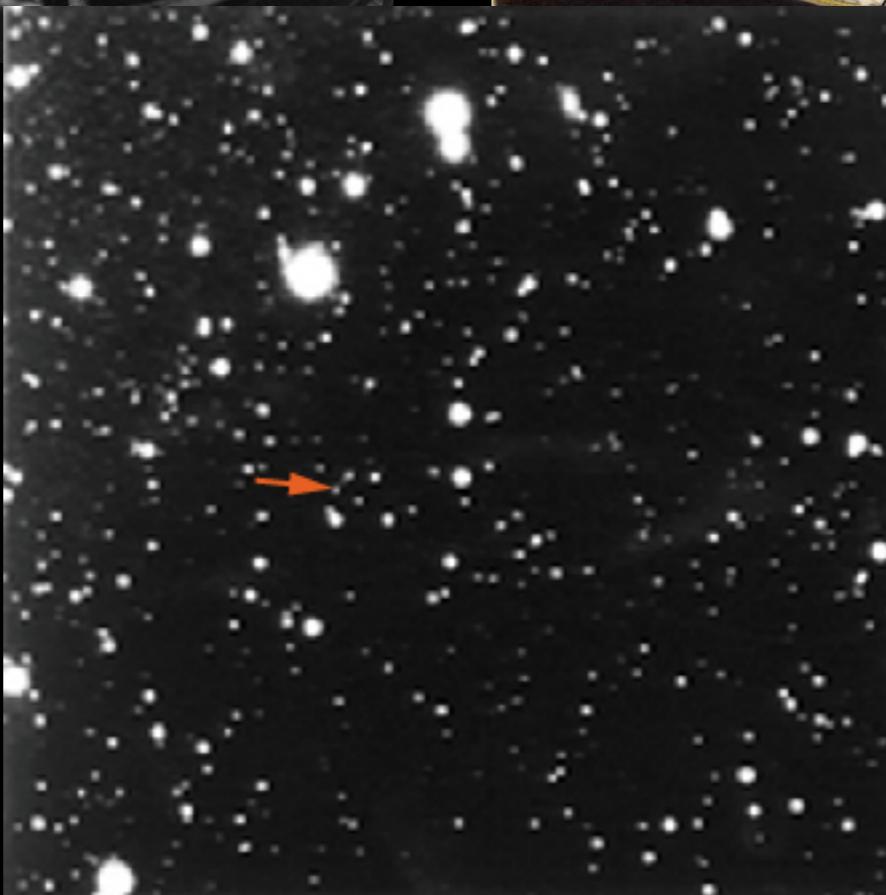
**THAT MOMENT YOU REALIZE
THAT PLUTO IS ON PLUTO.**



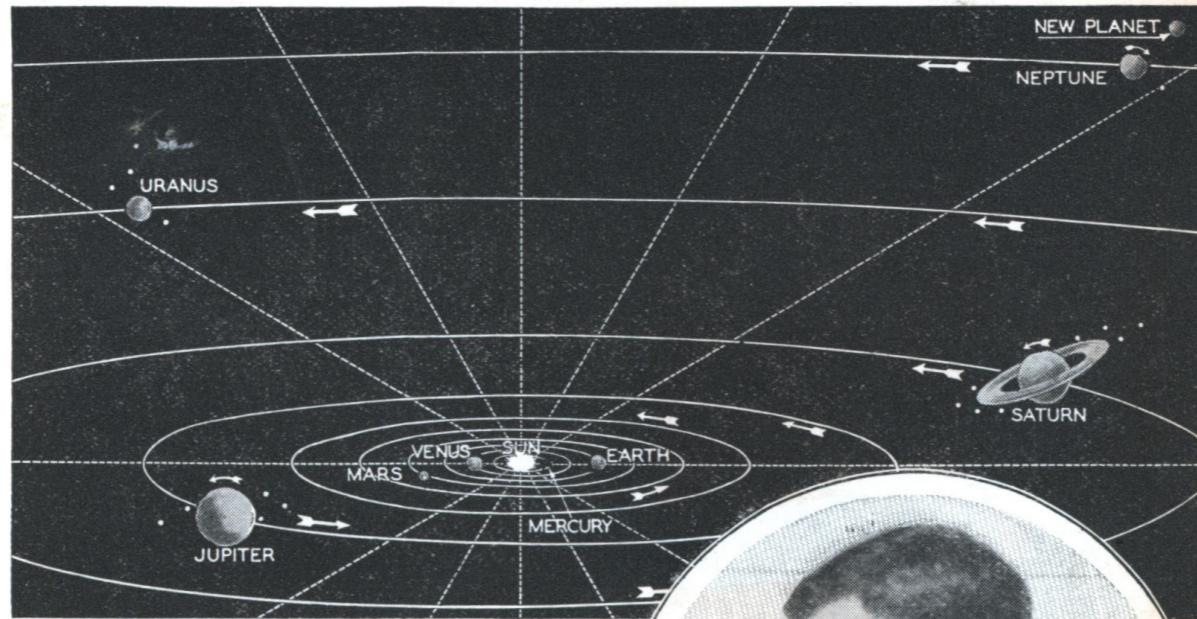
Search for and discovery of Pluto



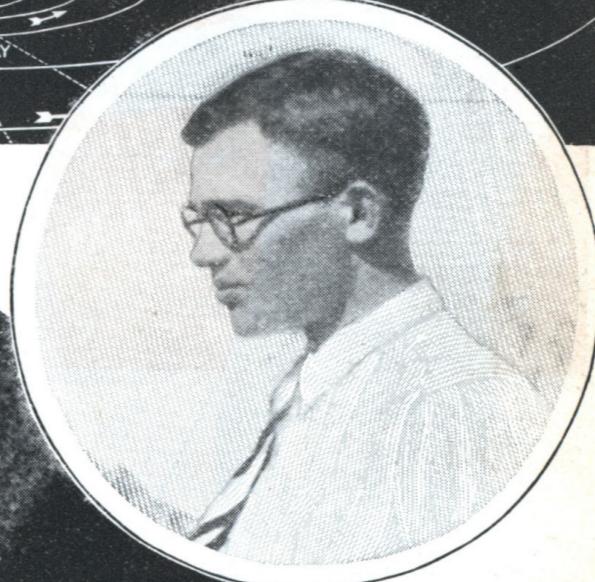
“Planet X”



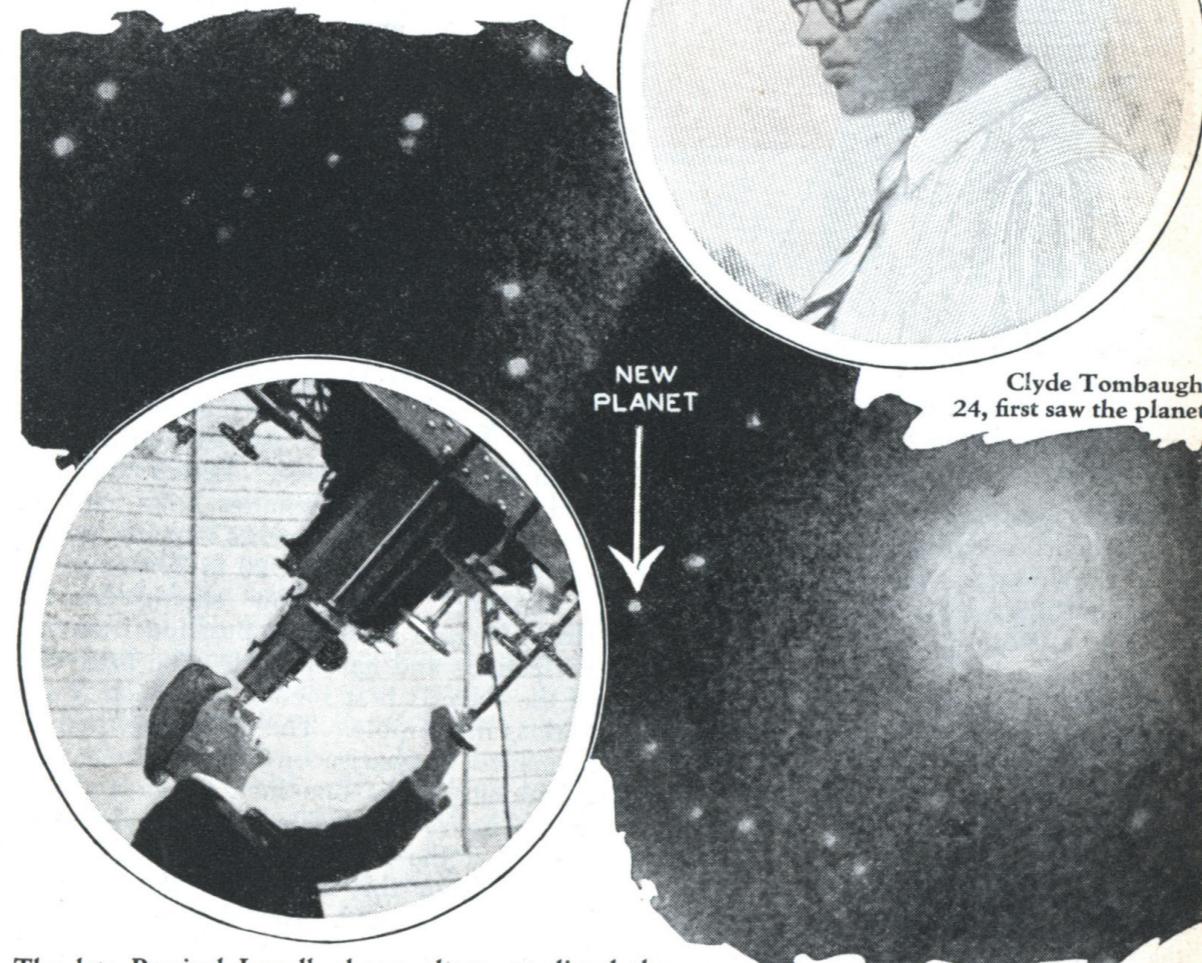
Astronomers Discover New Planet Out Beyond Neptune



The recently discovered planet, already named Pluto, is judged to be the same size as the earth.



Clyde Tombaugh,
24, first saw the planet.



The late Percival Lowell, shown above, predicted the planet's discovery 25 years ago. The picture of the planet was obtained with a 24-inch reflector and is from a 30-times enlargement of the plate. It was taken by Prof. George Van Biesbroeck of Yerkes Observatory at Williams Bay, Wisc. The bright glow on the plate is the near-by star, Delta Geminorum.

Basic facts about Pluto

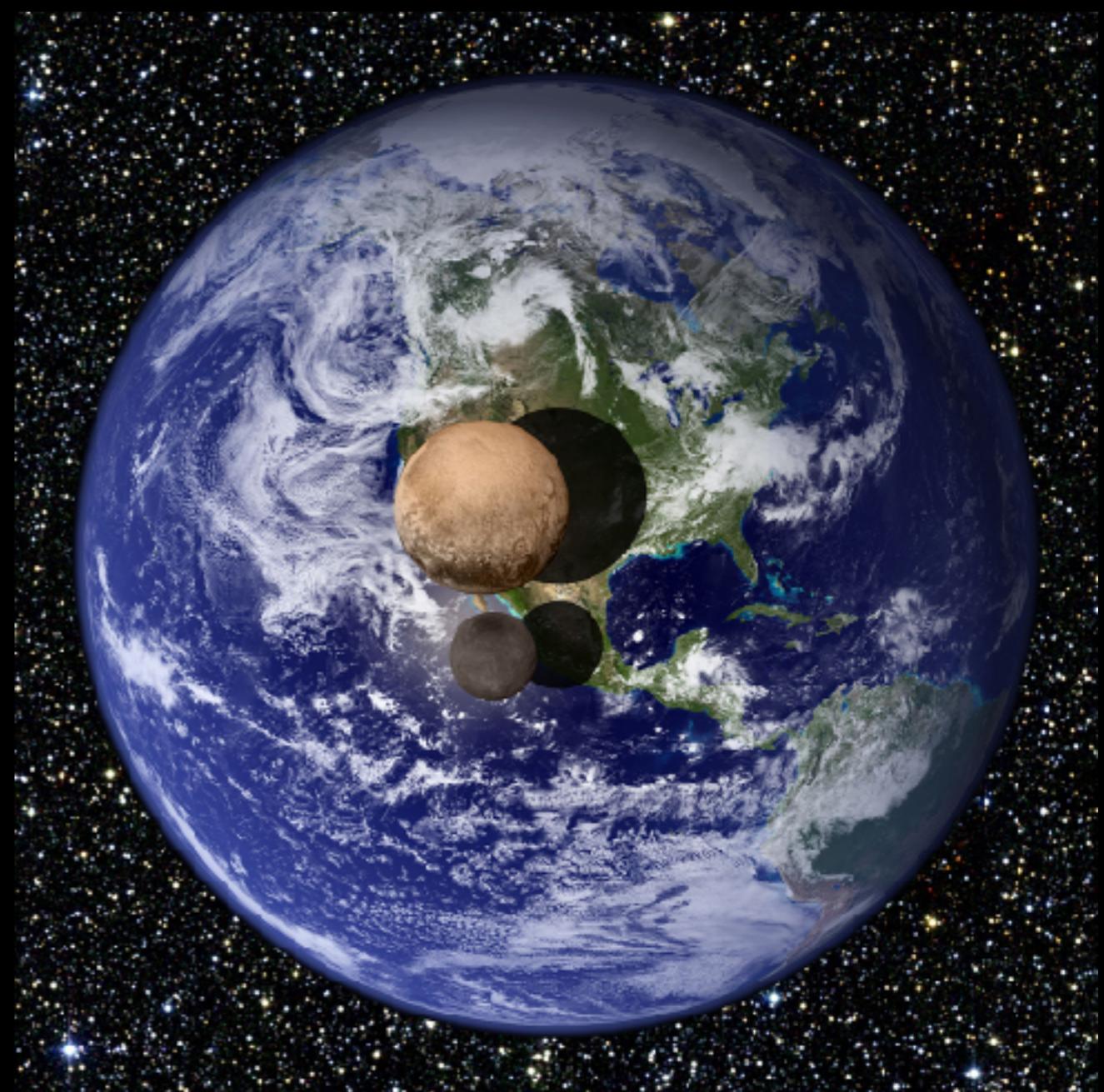
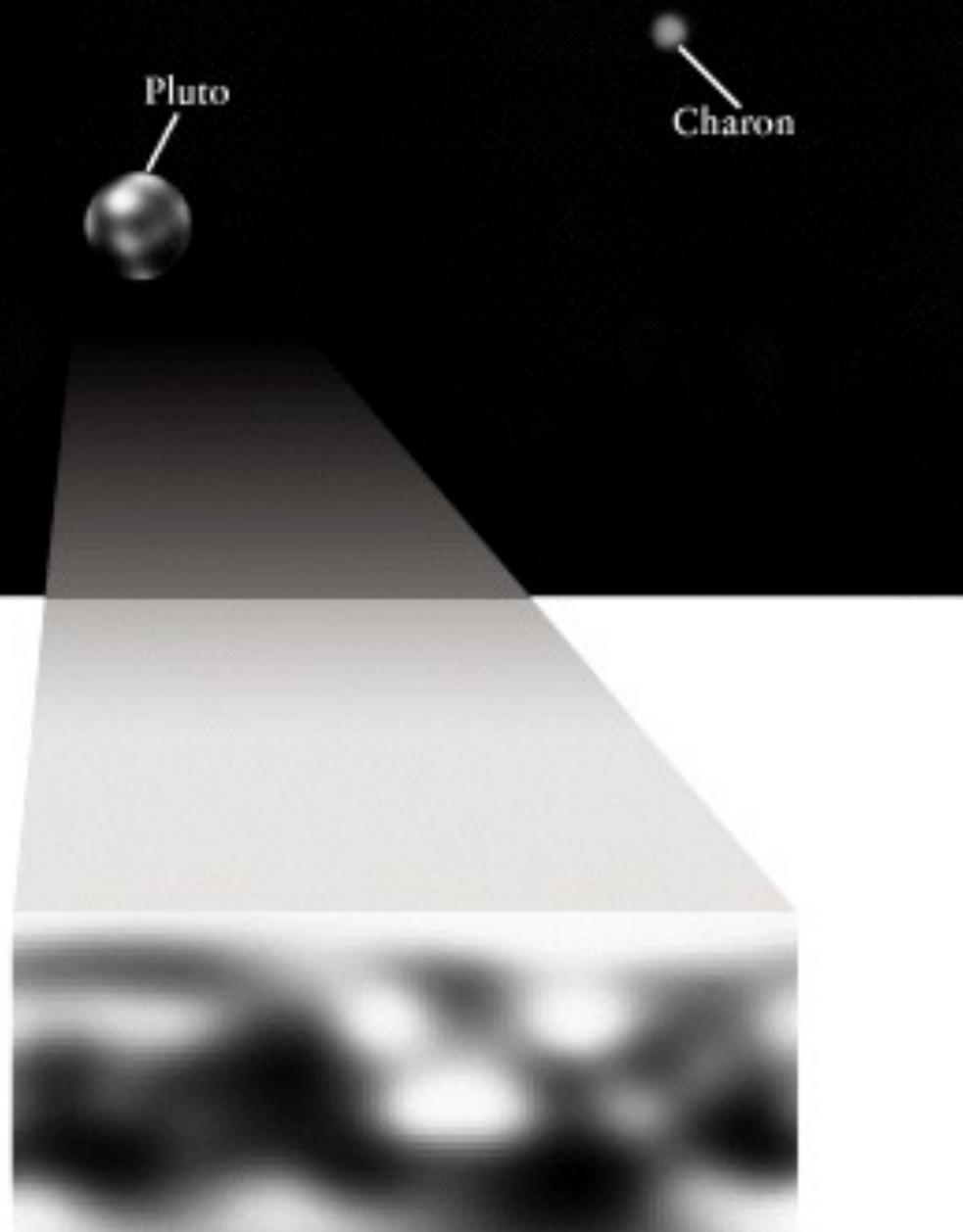
- Size: 1/6th the size of Earth (smaller than our moon!)
- Mass: 0.2% the mass of Earth
- On a somewhat eccentric, inclined orbit
- It has five moons
- “Demoted” from planet to dwarf planet in 2006
- It’s among the largest of the Trans-Neptunian Objects (TNOs)

Largest known trans-Neptunian objects (TNOs)



2000 km
—

Pluto and its main moon,
Charon, are about the
same size



What defines a planet?

1. Orbits the Sun
2. Round (or nearly round)
3. “Clears out the neighborhood” around its orbit

Why isn't Pluto a planet?

It is small, but size isn't *quite* the reason...

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Why isn't Pluto a planet?

It is small, but size isn't *quite* the reason...

1. Orbits the Sun
2. Round (or nearly round)
3. ~~“Clears out the neighbourhood” around its orbit~~

Pluto is now called a *dwarf planet*

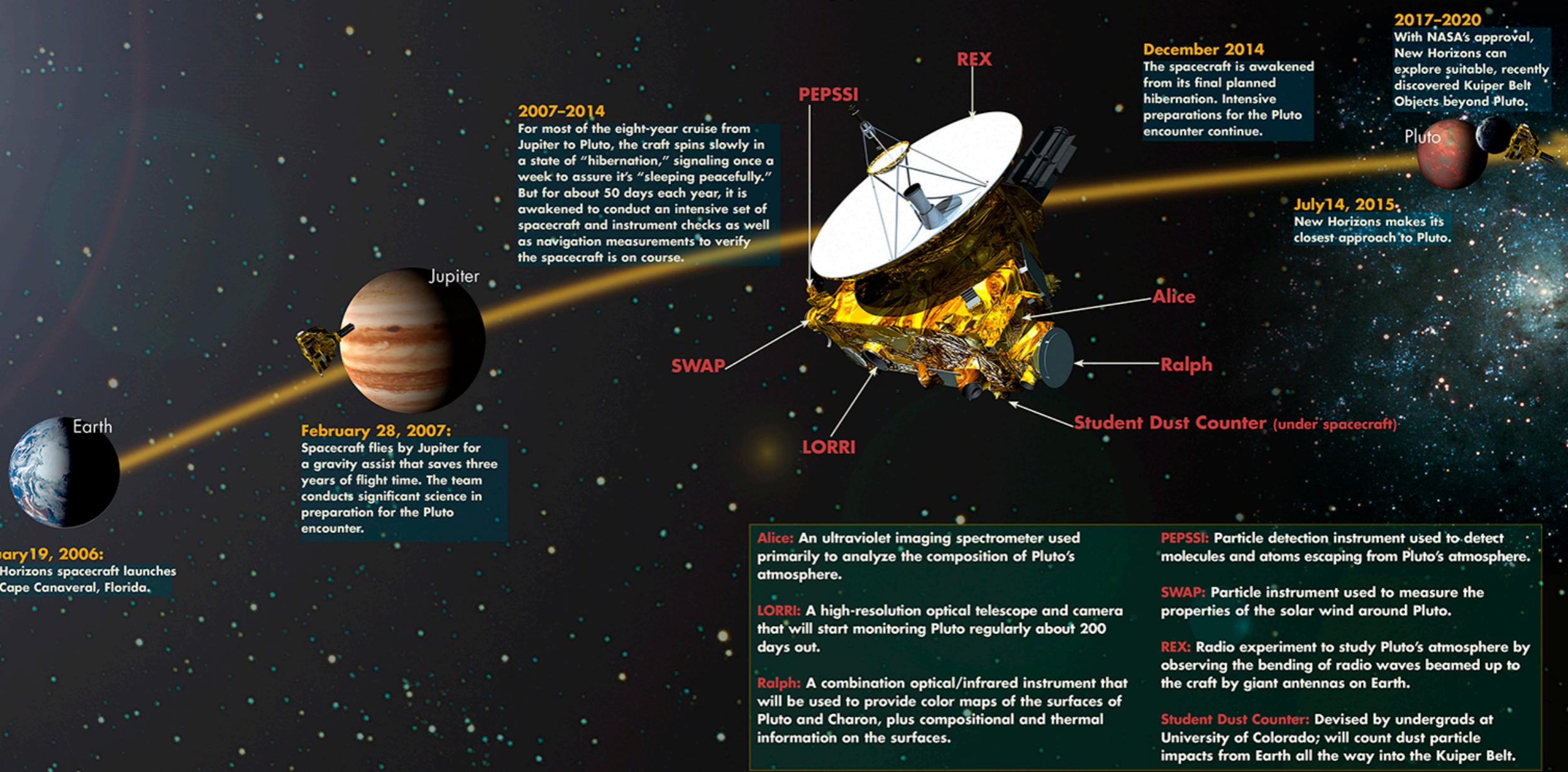
There are five officially recognized **dwarf planets** in the solar system.



But there could be *dozens of others* that have not yet been formally labeled.

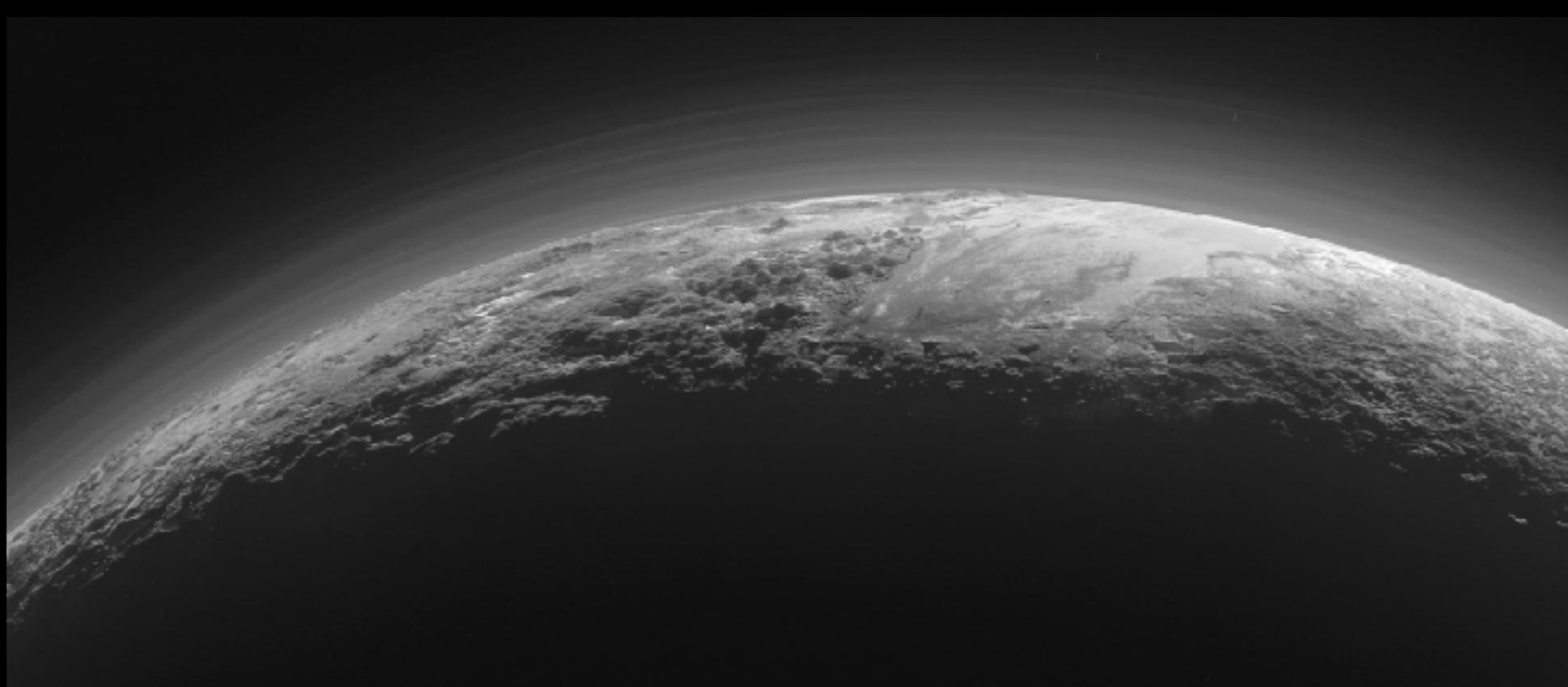
New Horizons probe visits Pluto!

Ten Years and Three Billion Miles...



What New Horizons found - atmosphere

- Very thin atmosphere when Pluto is closest to Sun
- Methane and nitrogen sublimate from ice
- 12 layers of haze



What New Horizons found - surface

- Dark areas covered with craters
- Surface “staining” from haze or chemical reactions
- Lowland light areas- seas of frozen nitrogen?



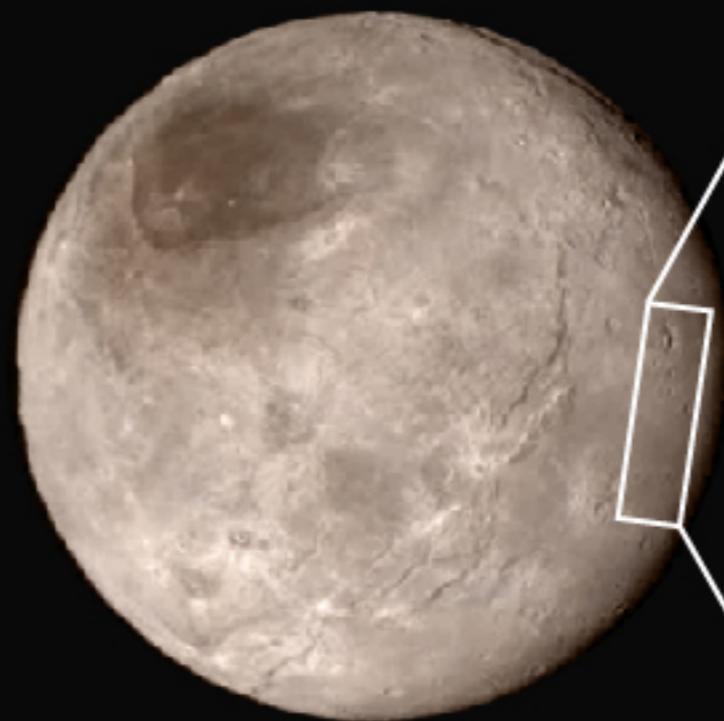
What New Horizons found - surface

- “Plains” – frozen nitrogen seas with mysterious boundaries
- Mountains of [water] ice
- Nitrogen ice flowing like glaciers?



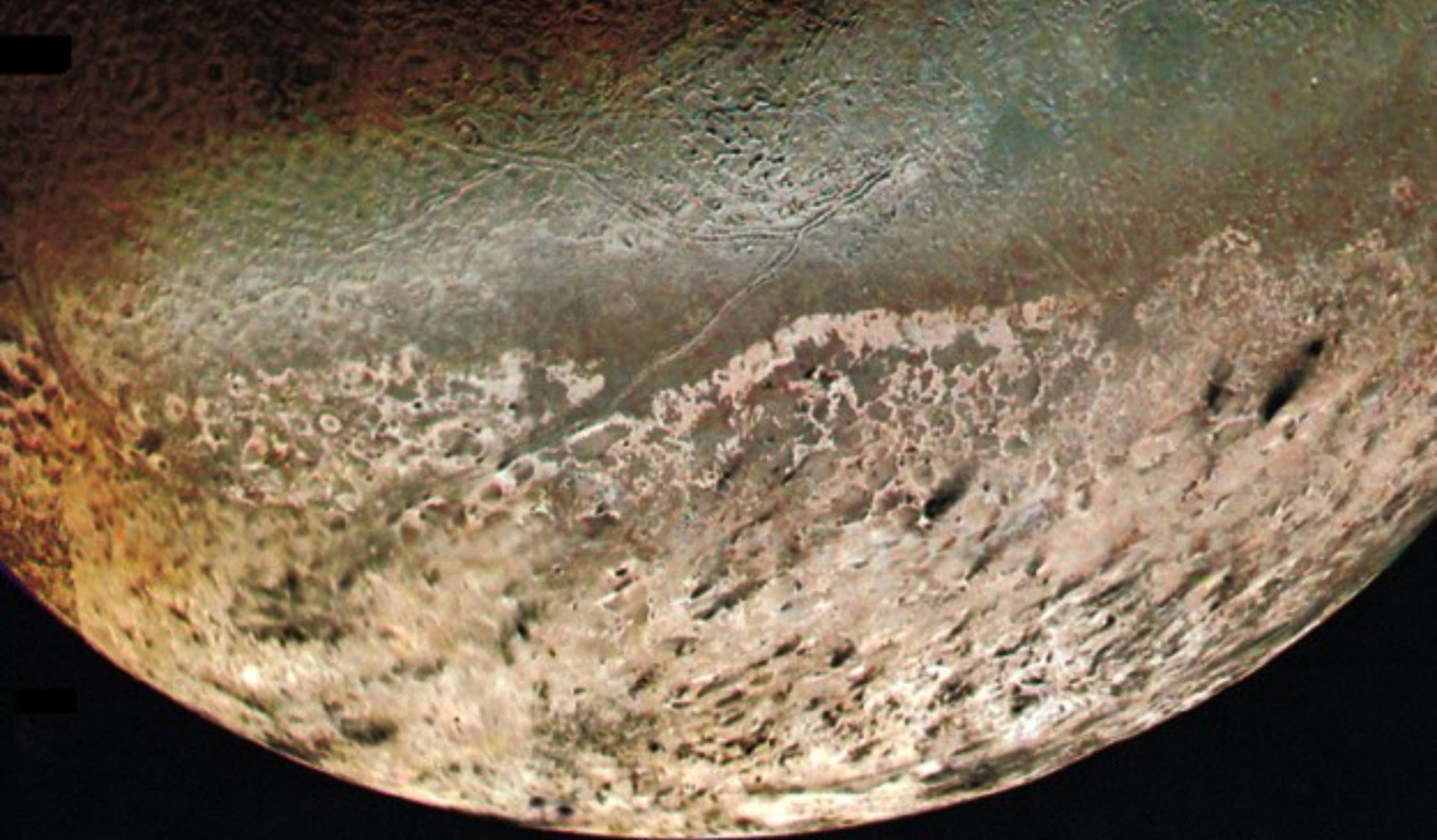
What New Horizons found - Charon

- Double tidal lock with Pluto- both always see each other's same side
- Redish polar cap
- Strange mountain in lowland depression feature



Moons of the Solar System- Nearly 200 known!

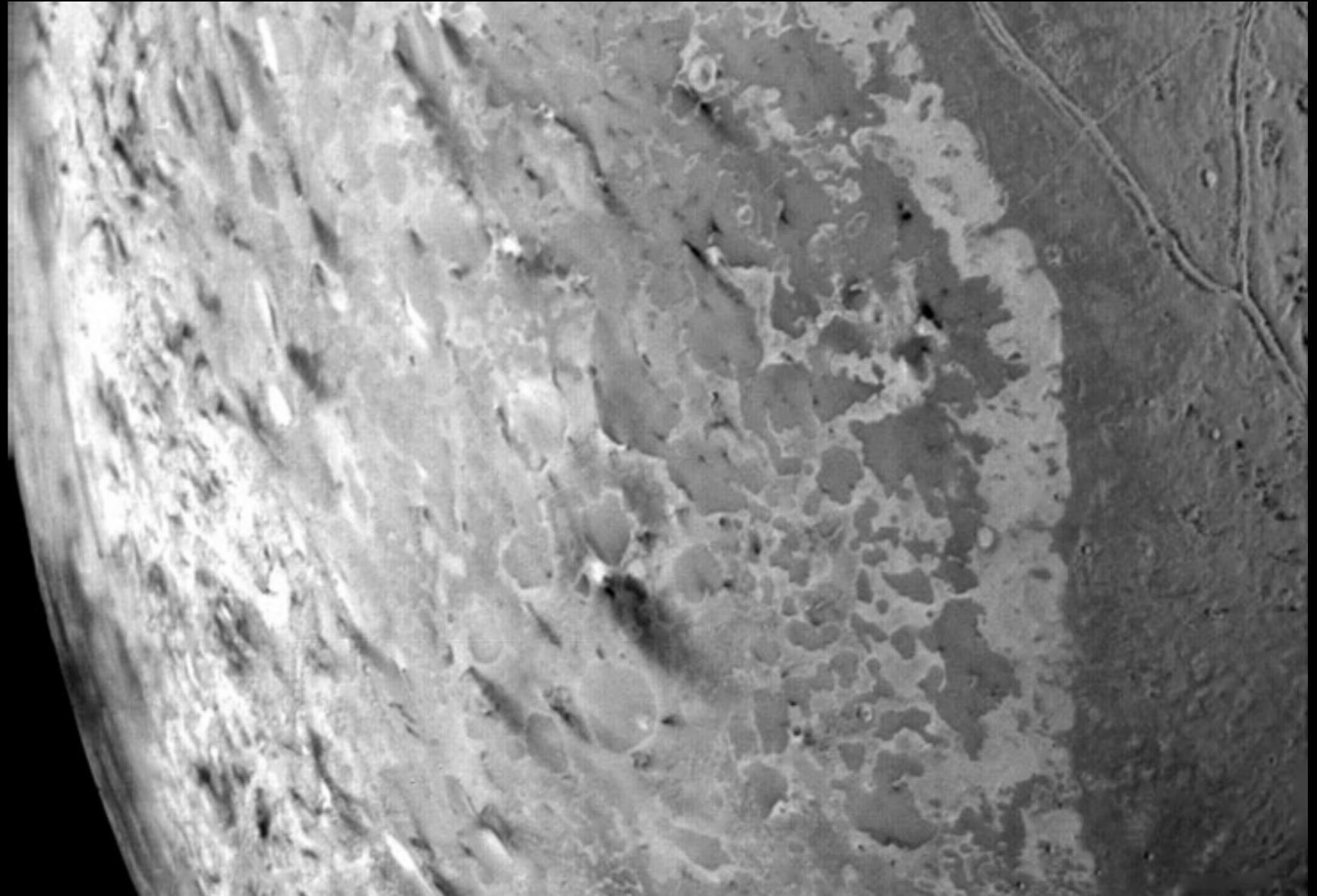




Neptune's largest moon, Triton, was probably captured by Neptune's gravity

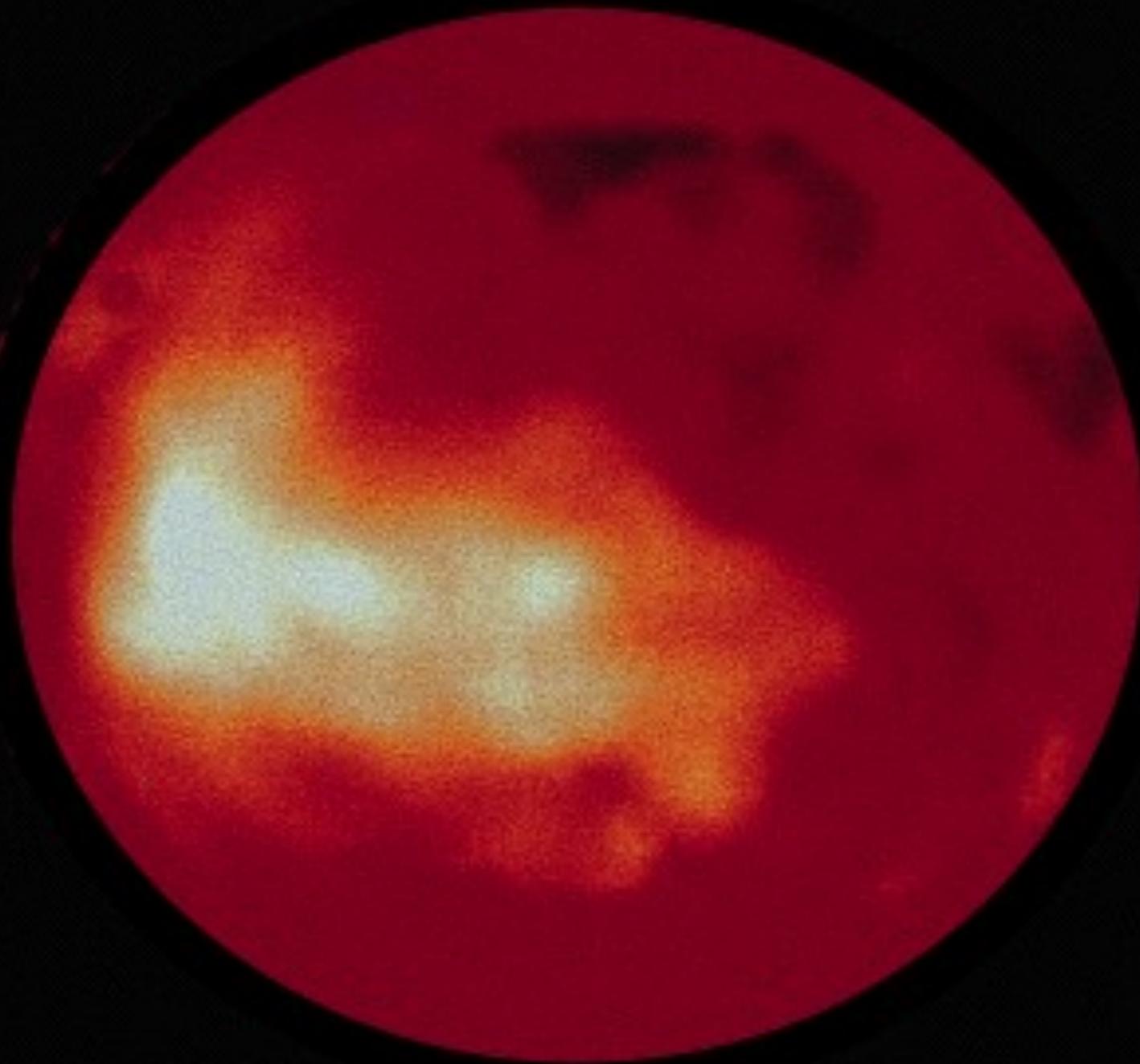
Triton is *very* cold... and it has geysers!

From the
Voyager 2
flyby



Plumes of nitrogen gas 10km high created when
Sun warms the south polar cap a bit.

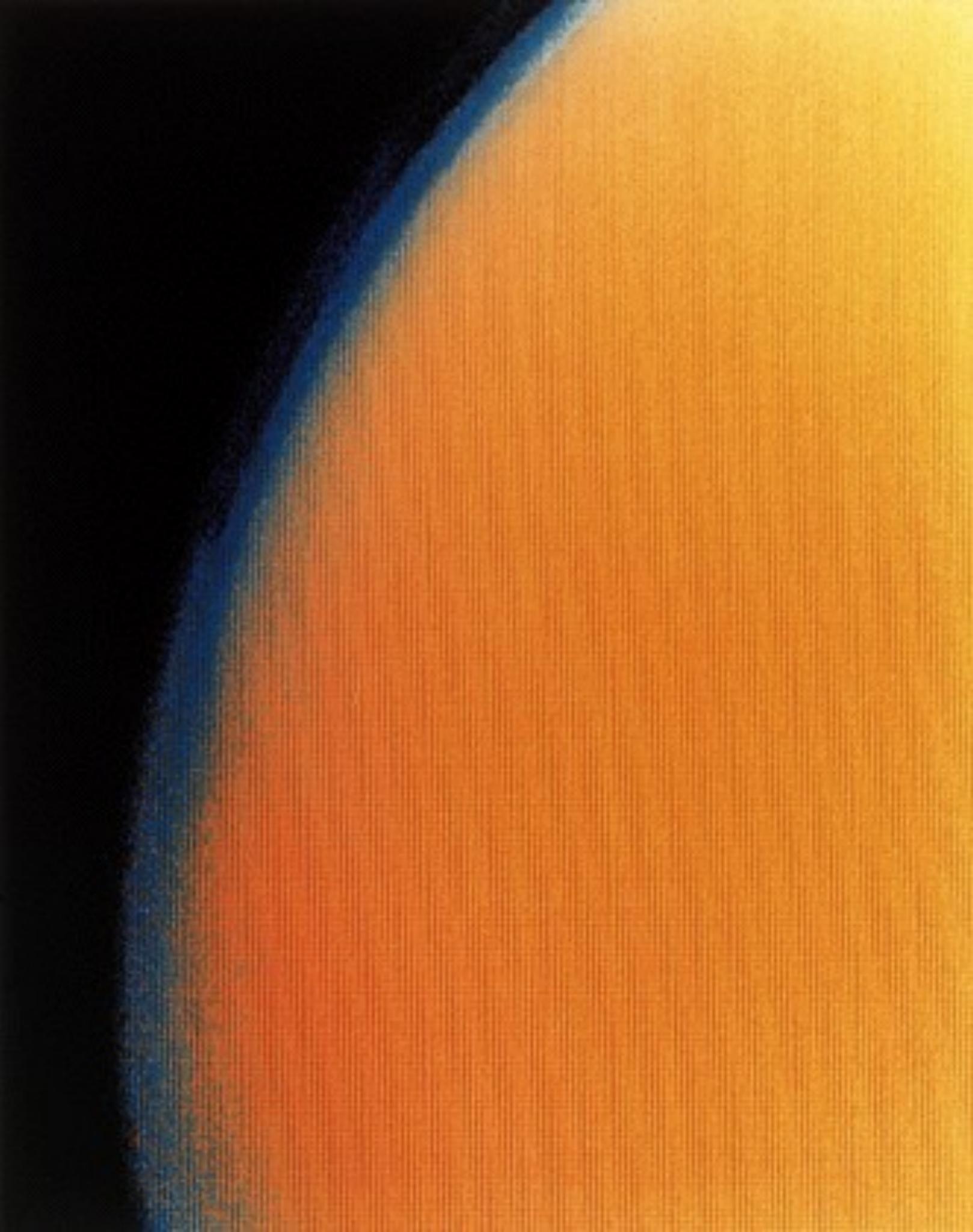
Titan is Saturn's largest moon



About the size of Callisto or Ganymede orbiting Jupiter.

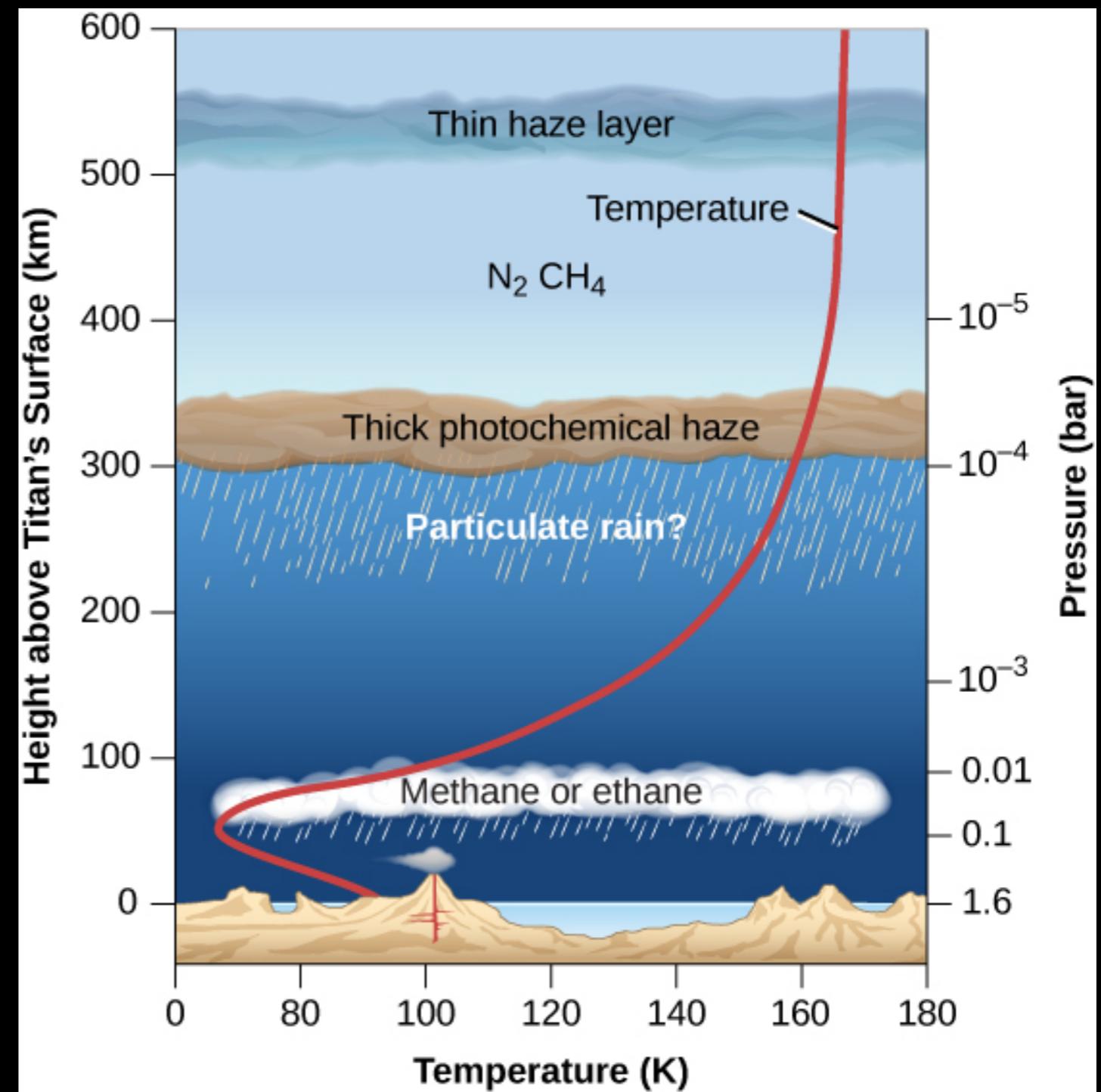
Titan has a thick,
opaque
atmosphere rich in
nitrogen, methane
and other
hydrocarbons

*(including ethane,
acetylene, ethylene,
and propane)*



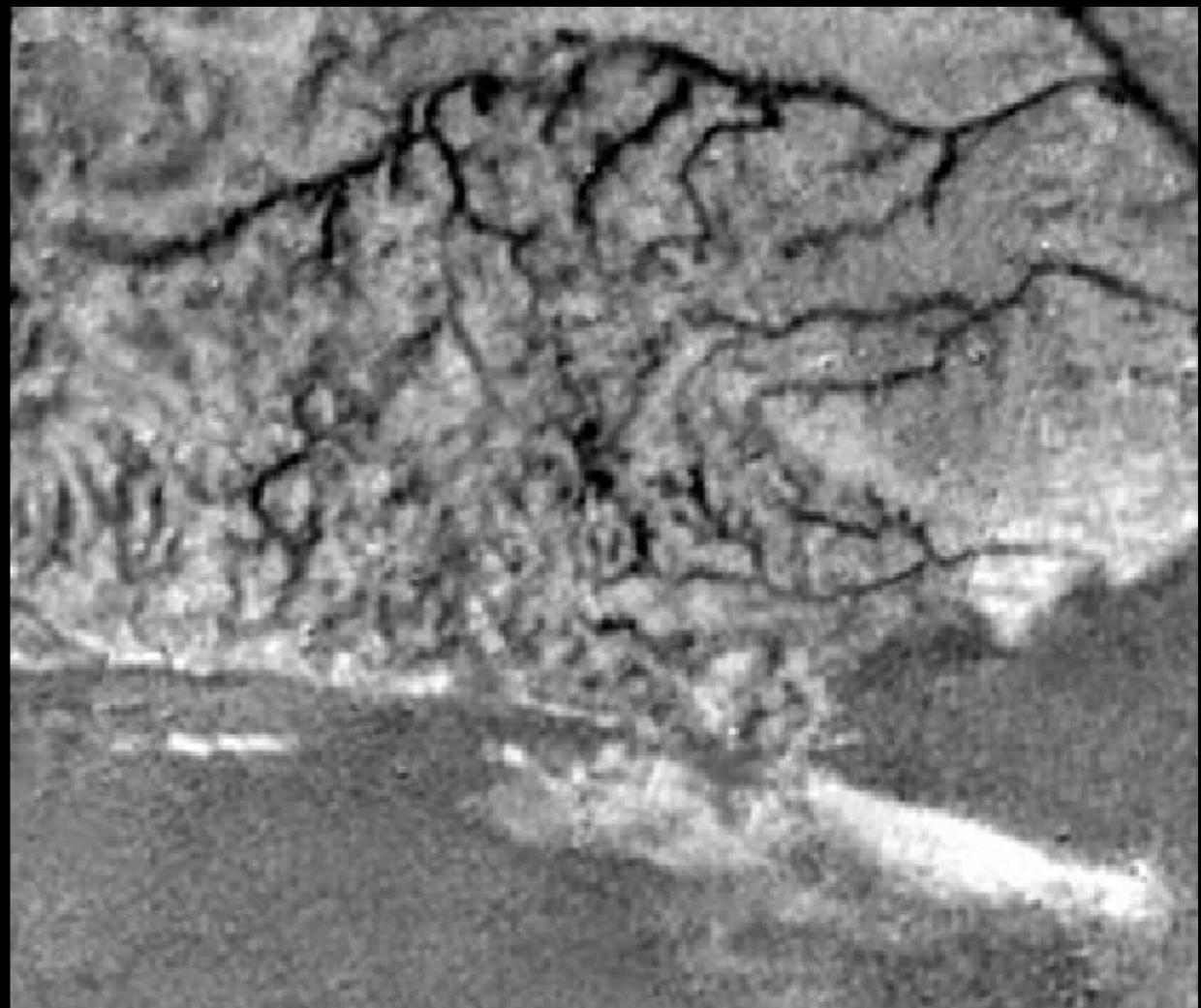
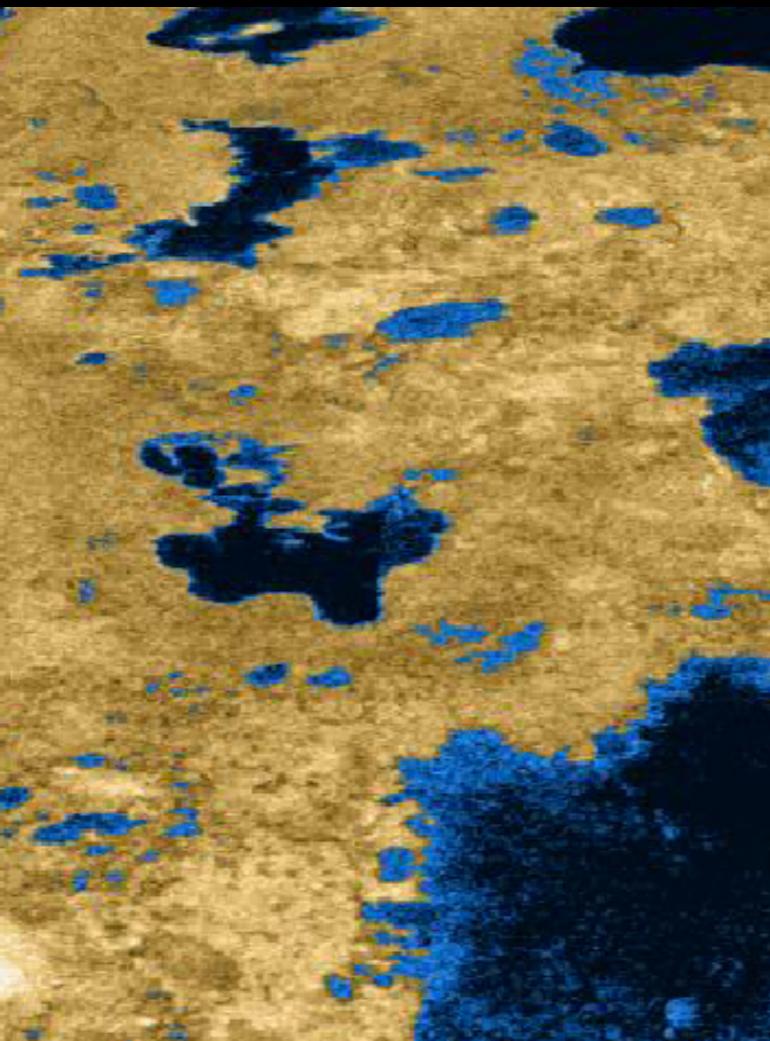
What Voyager found out about Titan

- Its atmosphere has some things in common with Earth:
 - mostly nitrogen
 - it has a form of rain coming down
- There are lakes and rivers... of methane and ethane



The Cassini-Huygens mission visited Titan more recently (2005)

- Cassini orbiter took images of methane lakes
- Methane can evaporate into atmosphere
- It can also fall back down as rain, forming rivers



The Huygens probe parachuted down to Titan's surface!



<https://youtu.be/msiLWxDayuA>

Huygens took images for about an hour before it became too cold to operate...

Meanwhile, the Cassini orbiter continued to work until 2017 when it was steered into Saturn following its successful two-decade mission.