

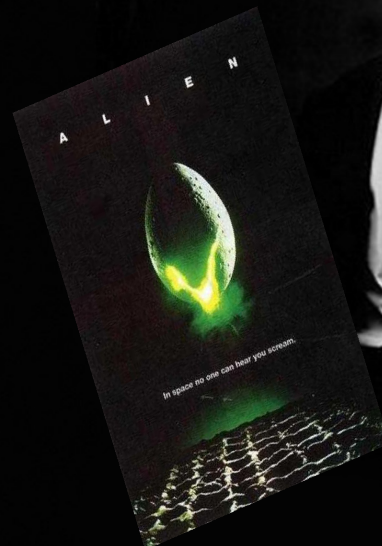
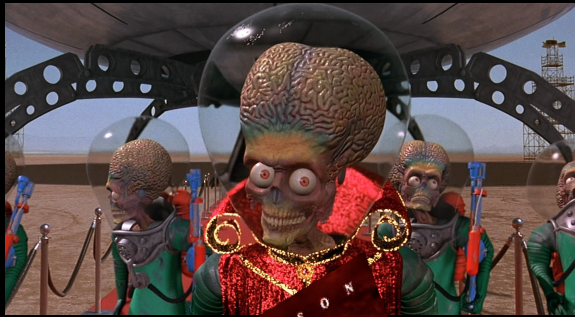
SETI -

*Search for Extra-terrestrial Intelligence -
Perspectives of an Earth Scientist*



*Donna M. Jurdy
Northwestern University*





Mars • Global Dust Storm

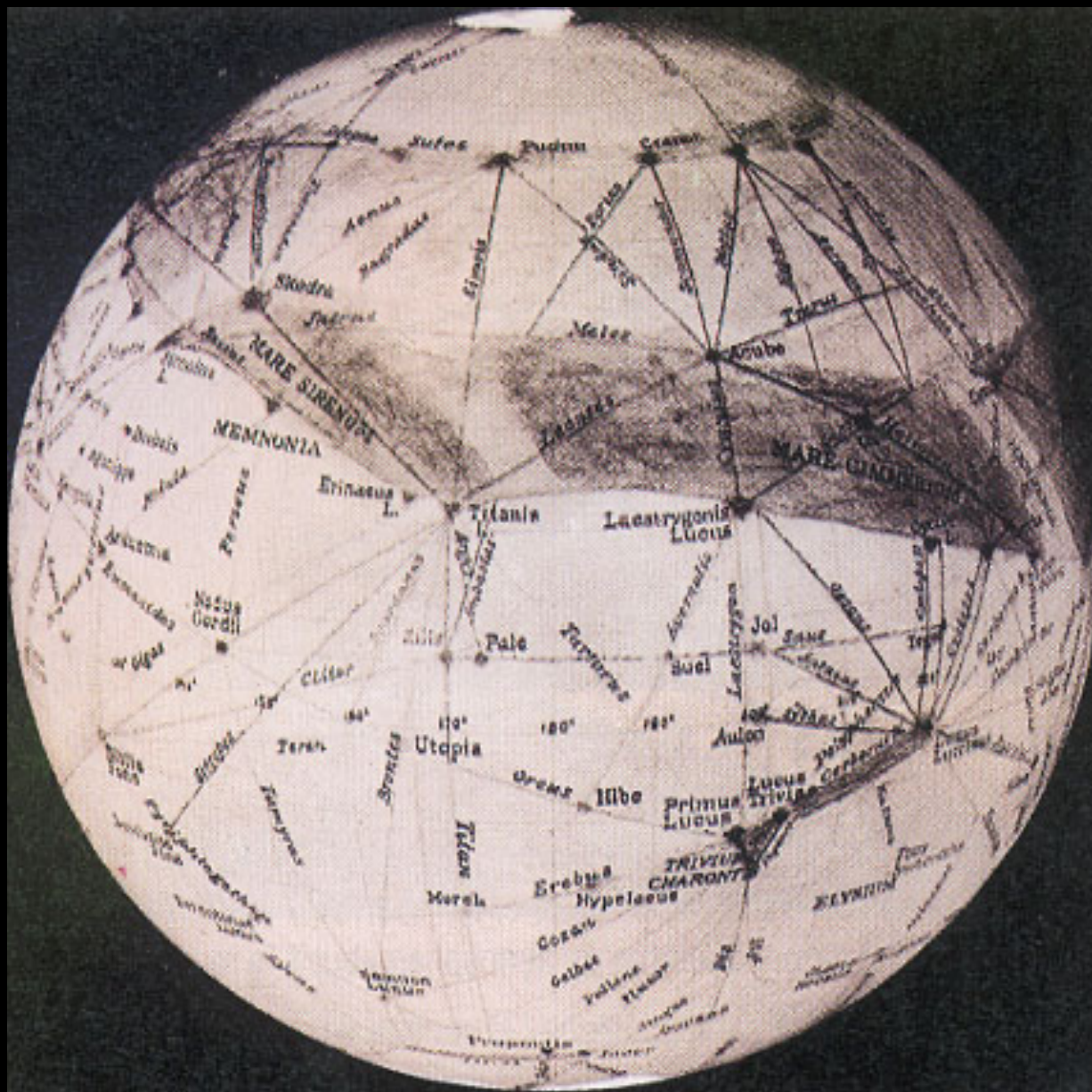


June 26, 2001



September 4, 2001

Hubble Space Telescope • WFPC2

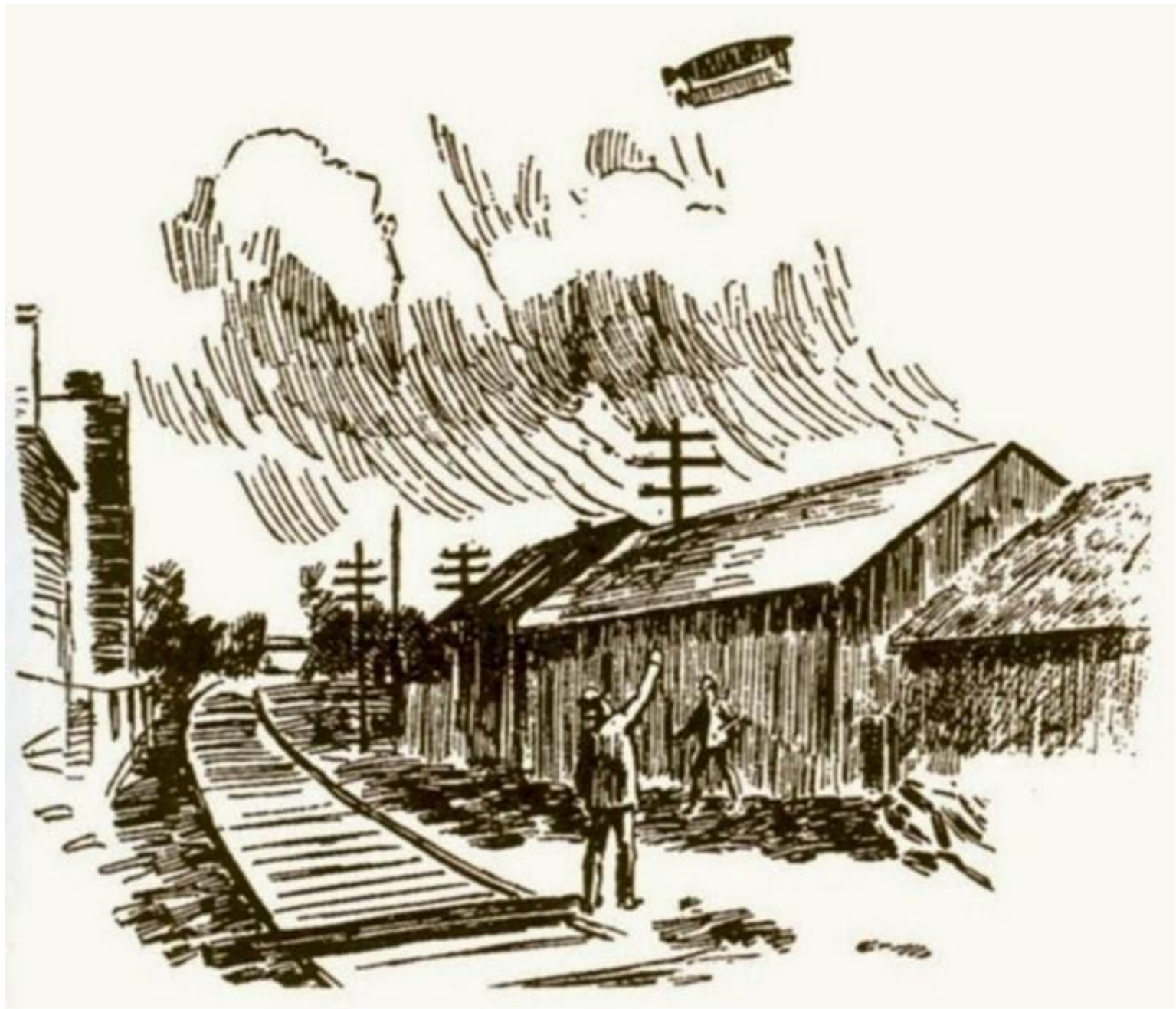


The WAR of the WORLDS

By H. G. Wells

Author of "Under the Knife," "The Time Machine," etc.

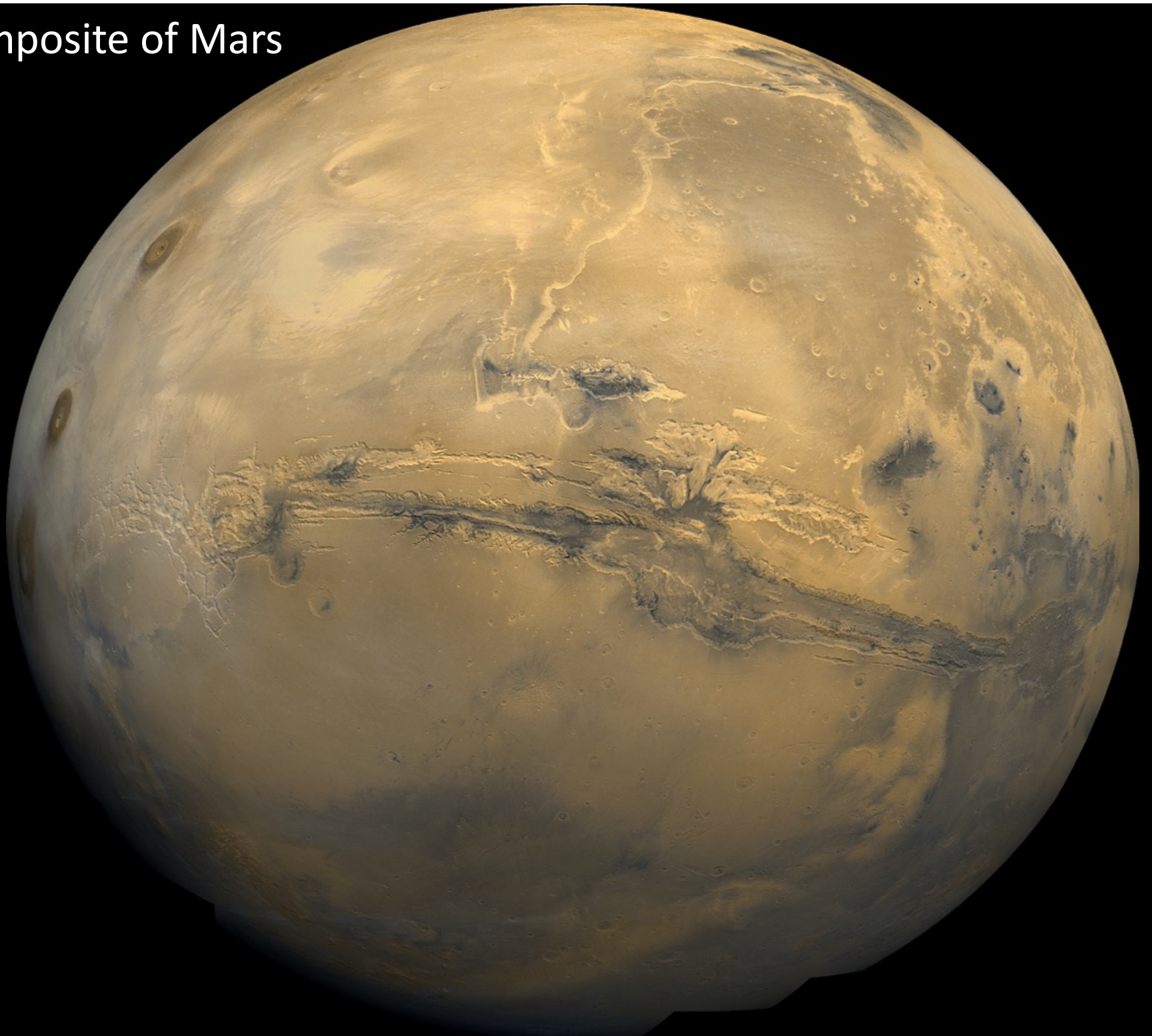




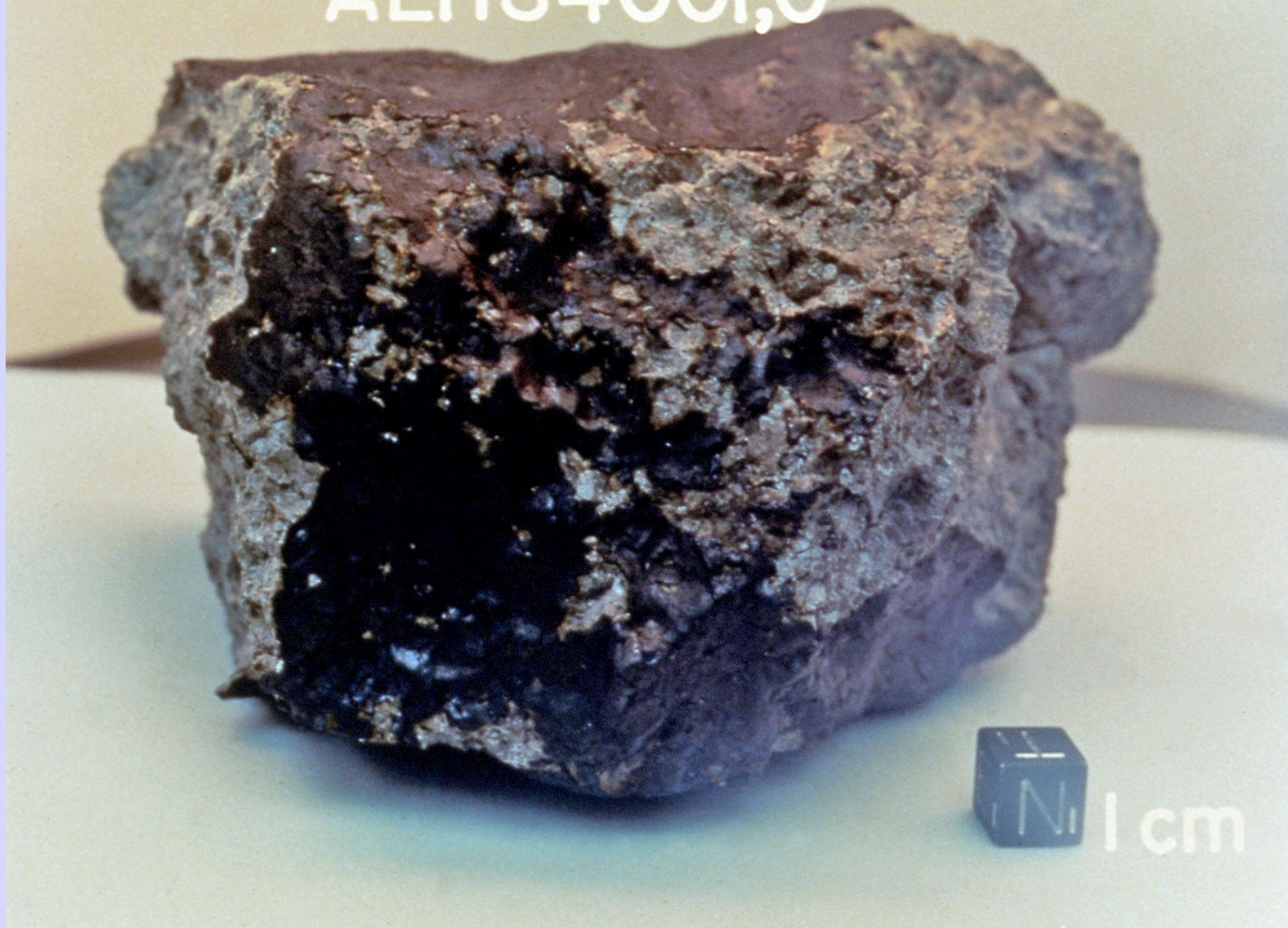


Viking composite of Mars

mid 1970's

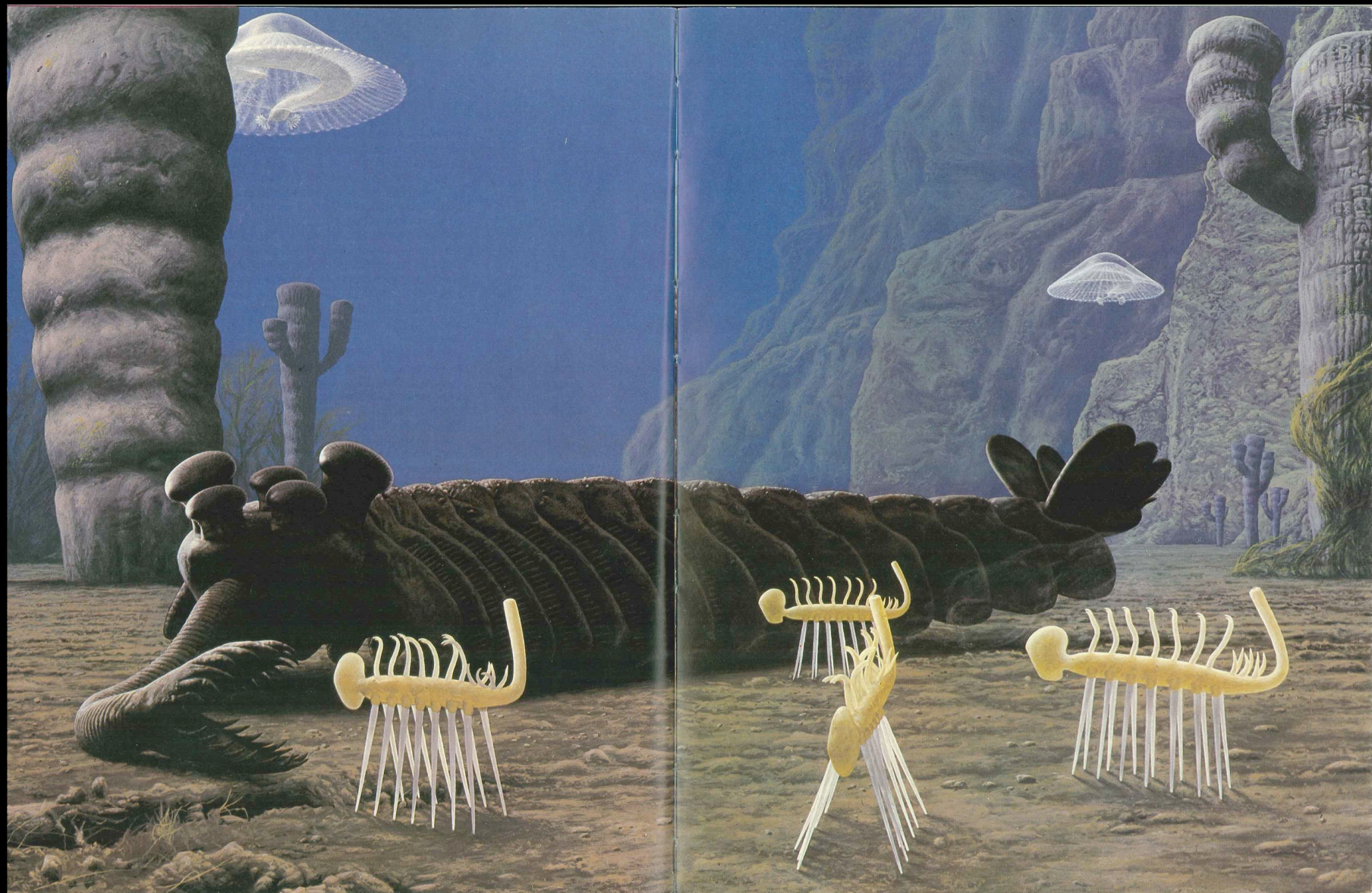


ALH84001,0



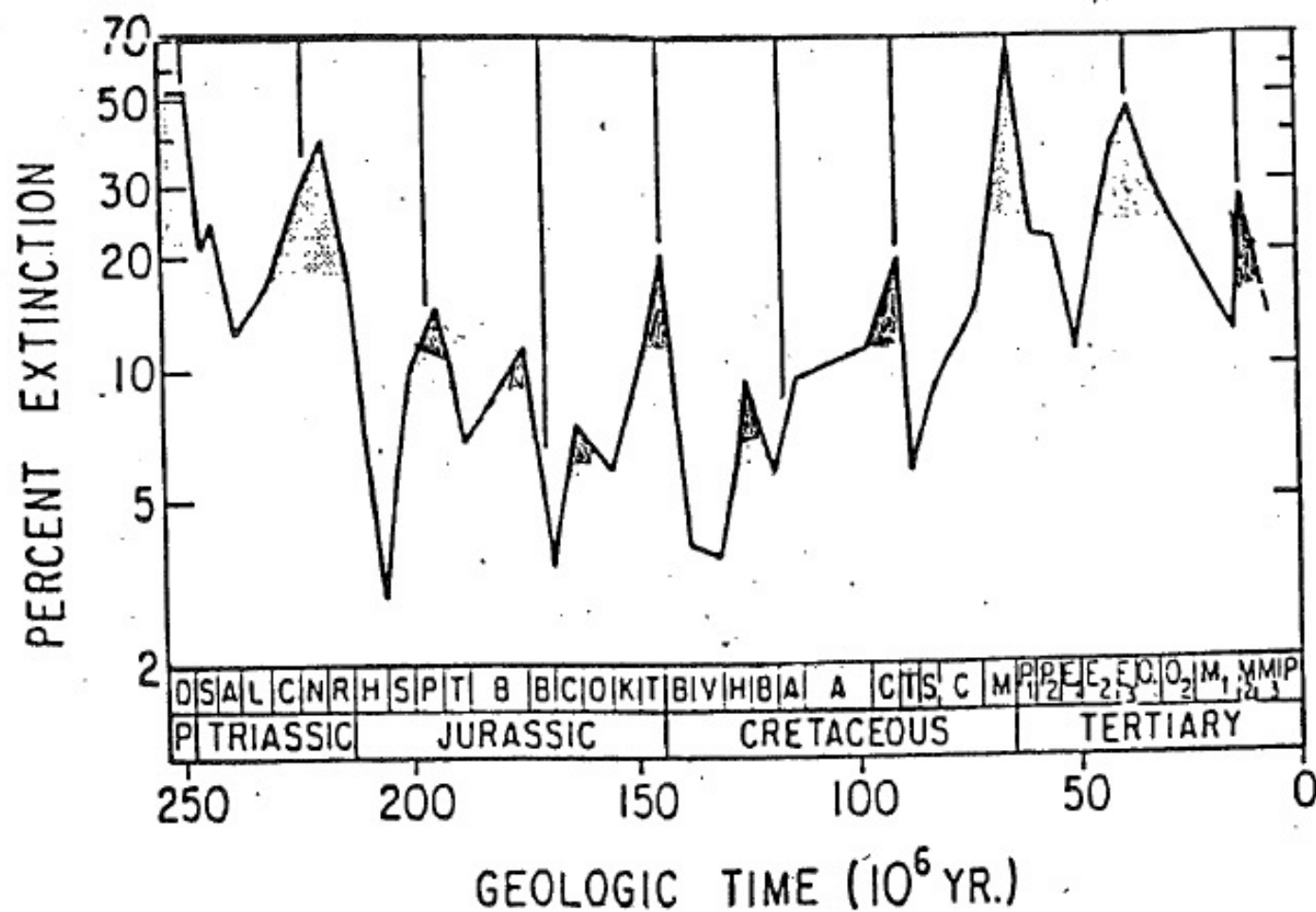
ALH84001 thin section – Martian fossils?

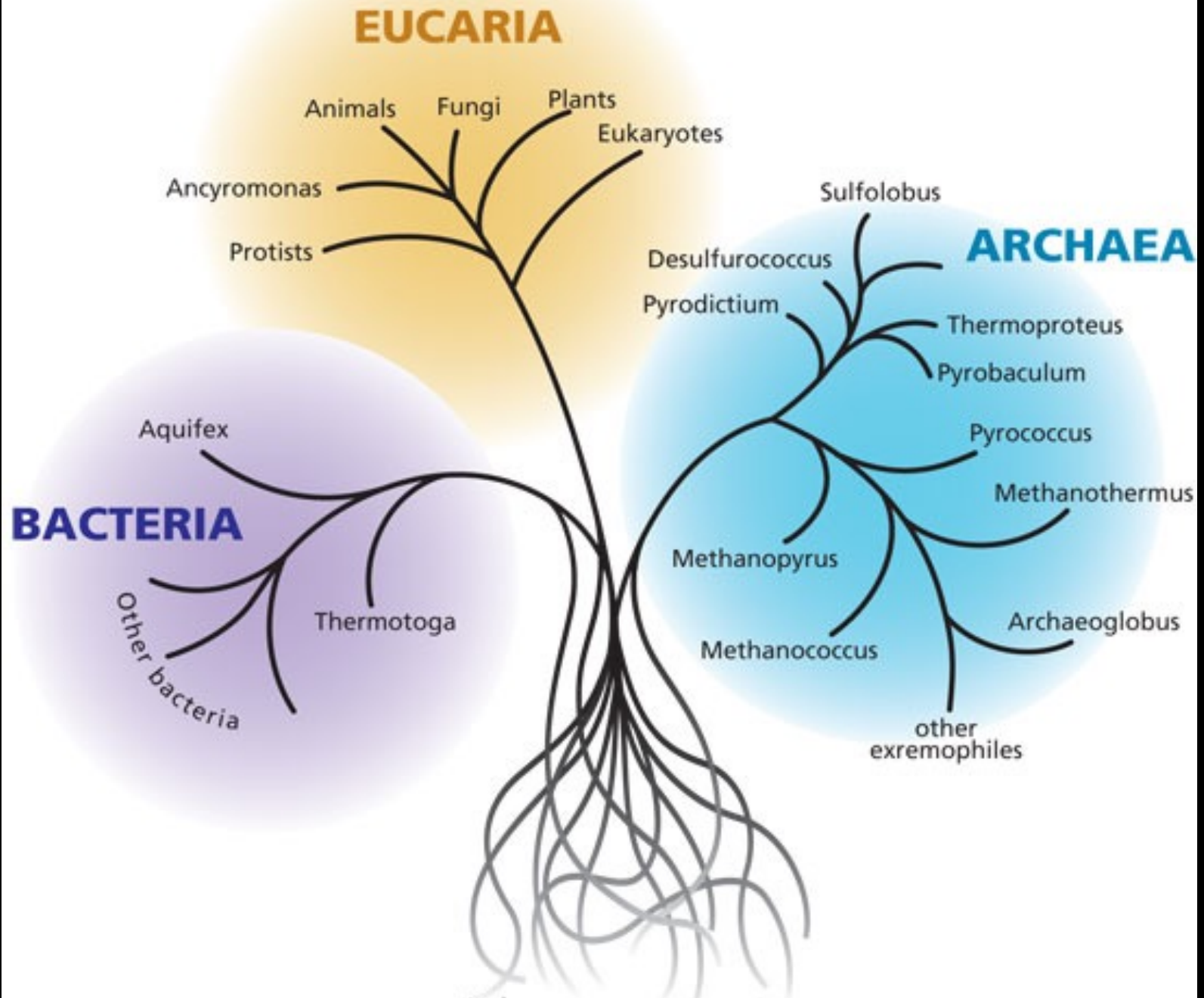


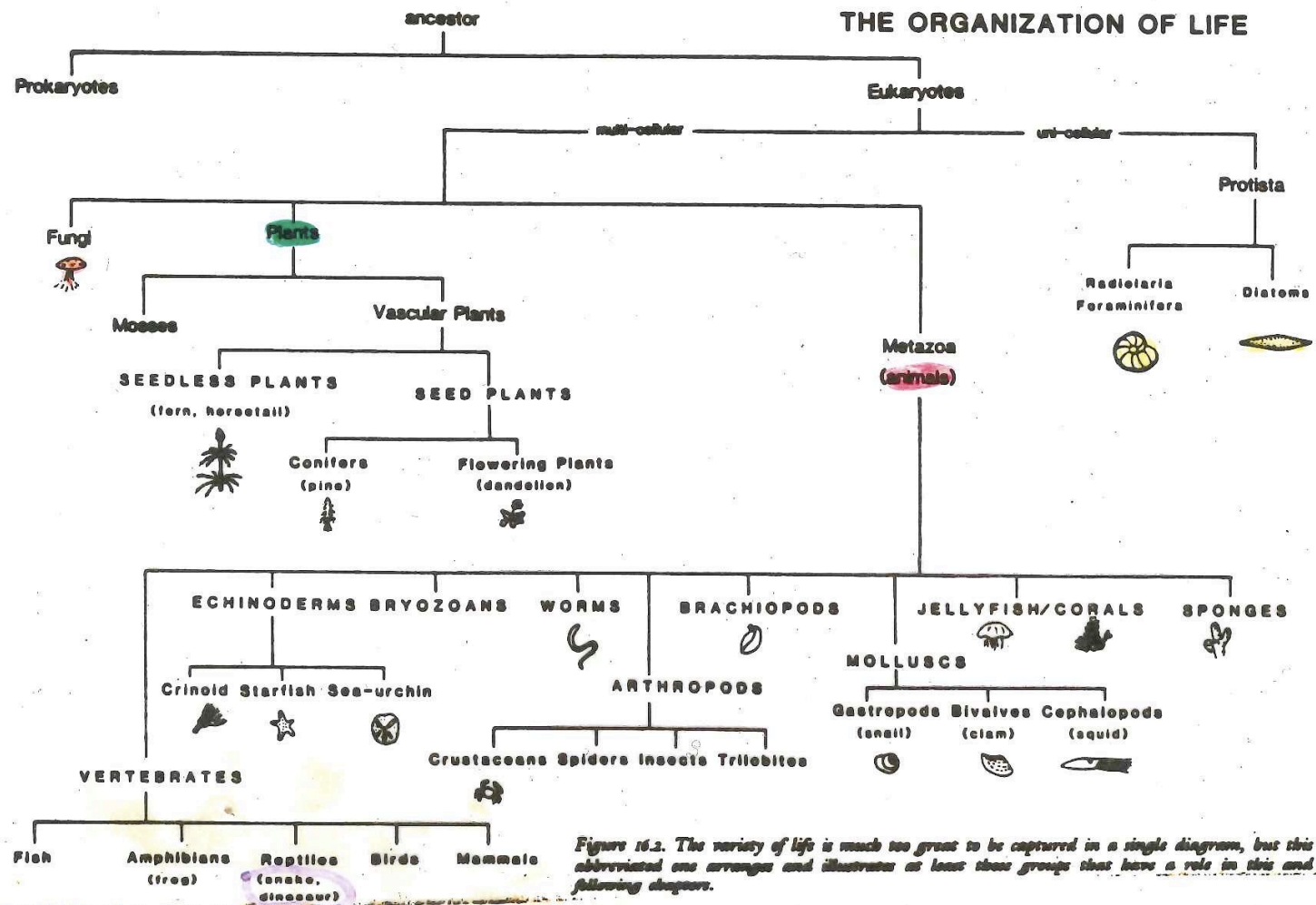


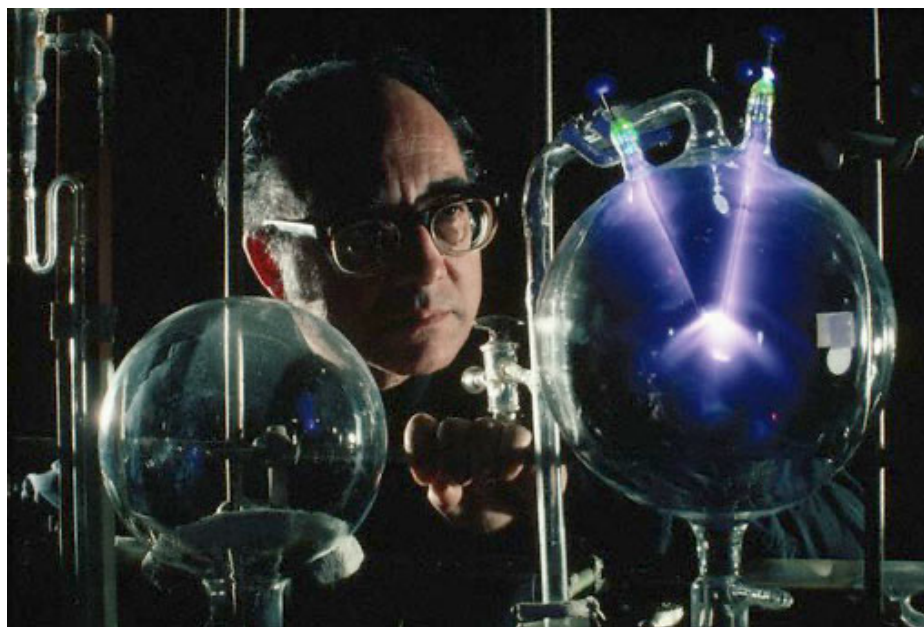
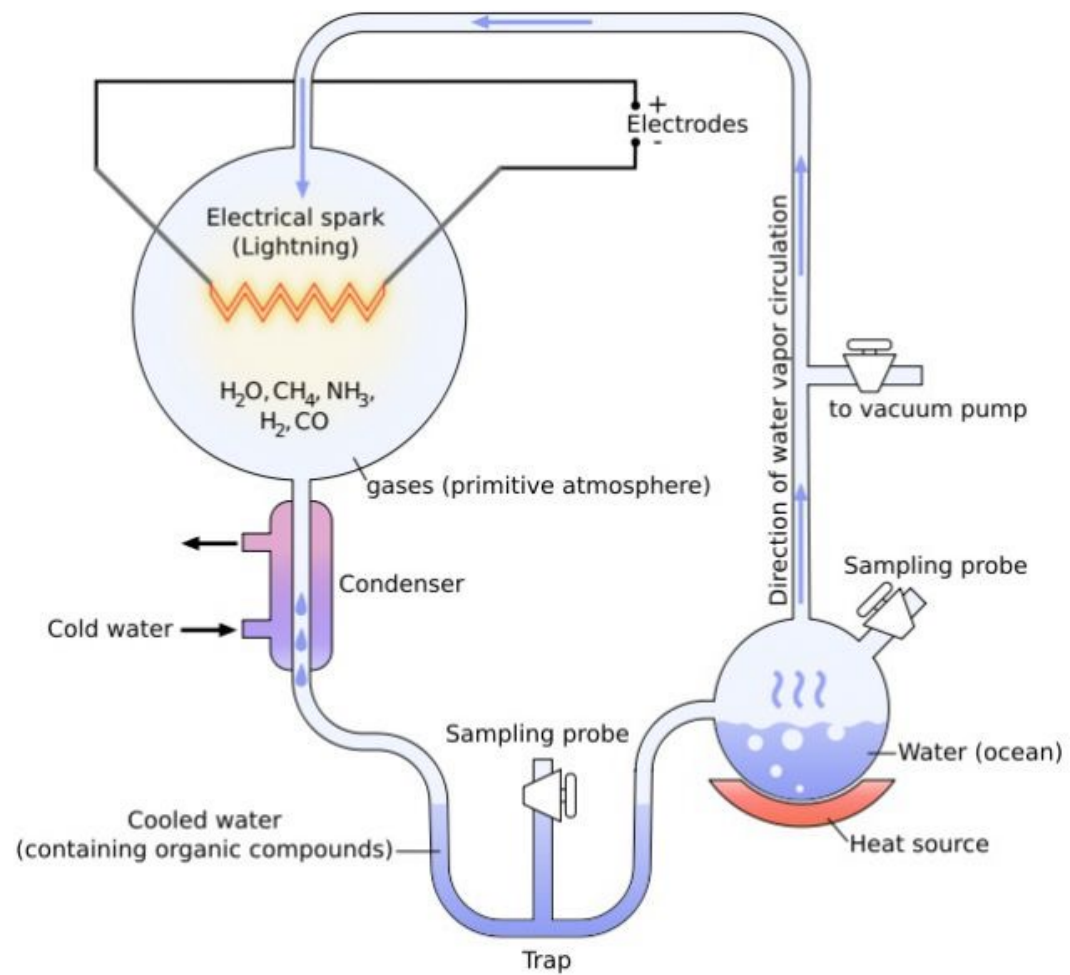


from: Raup & Sepkowski, "Periodicity of extinctions in the geologic past"
 Proc. National Academy of Sciences, vol. 81, pp. 801-805, 1984.







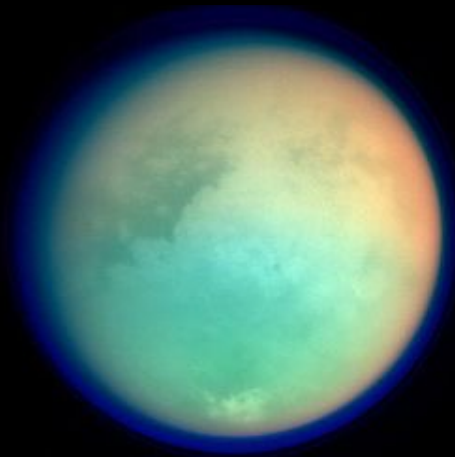


Life in the Solar System?

Pole-to-Equator Temperature Difference on Other Planets



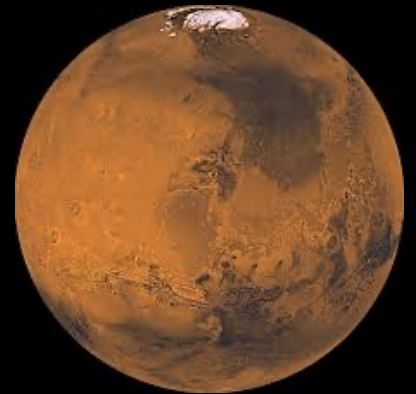
~ 0 K



~ 4 K



a few 10 K



a few (more) 10 K



Thicker Atmosphere

Needed for Habitability?

Solid surface

Atmosphere

Liquid on surface:

Need not be water

PHI – Planetary Habitability Index:
Schulze-Makuch et al., 2011



HABITABILITY INDEX



EARTH
0.96



TITAN
0.64

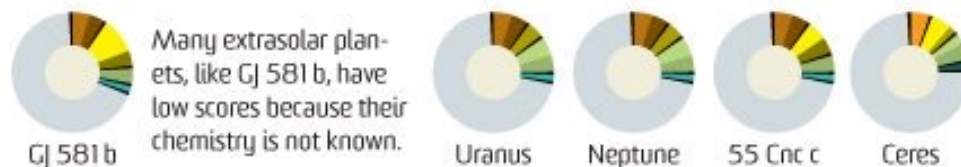
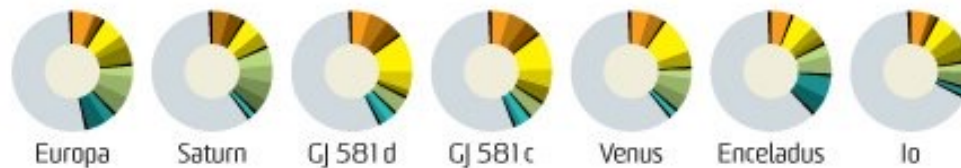
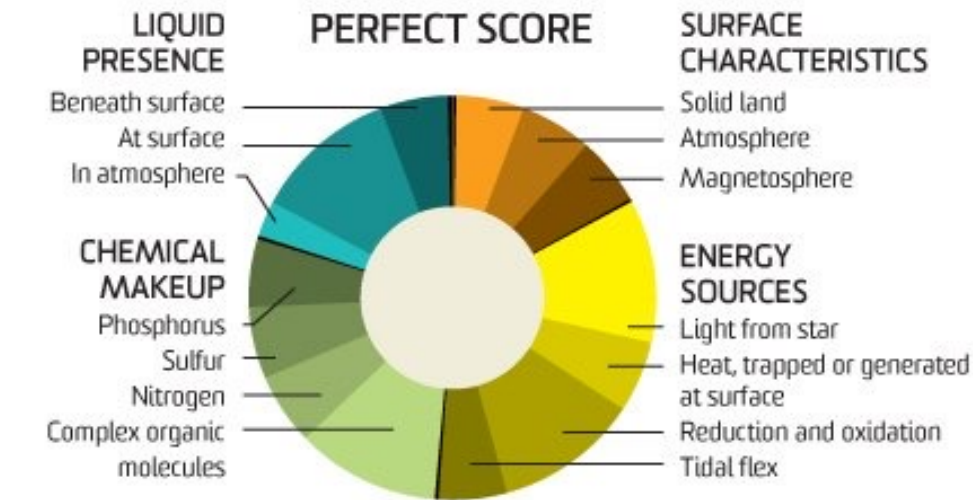


MARS
0.59



GLIESE 581D
0.43

Habitability Index



Earth = 0.96

Titan = 0.64

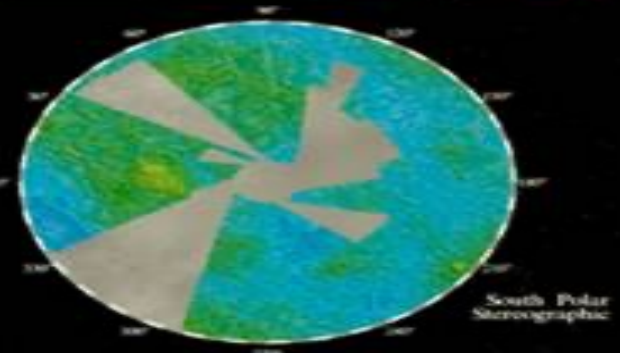
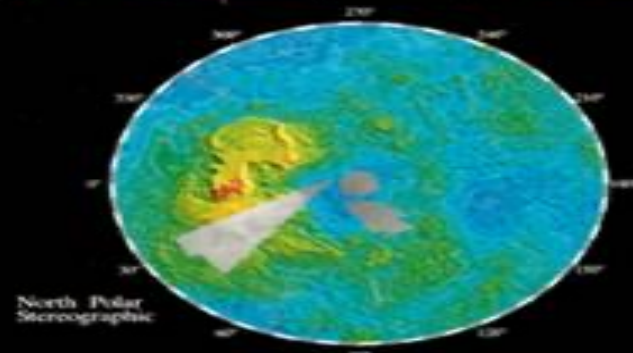
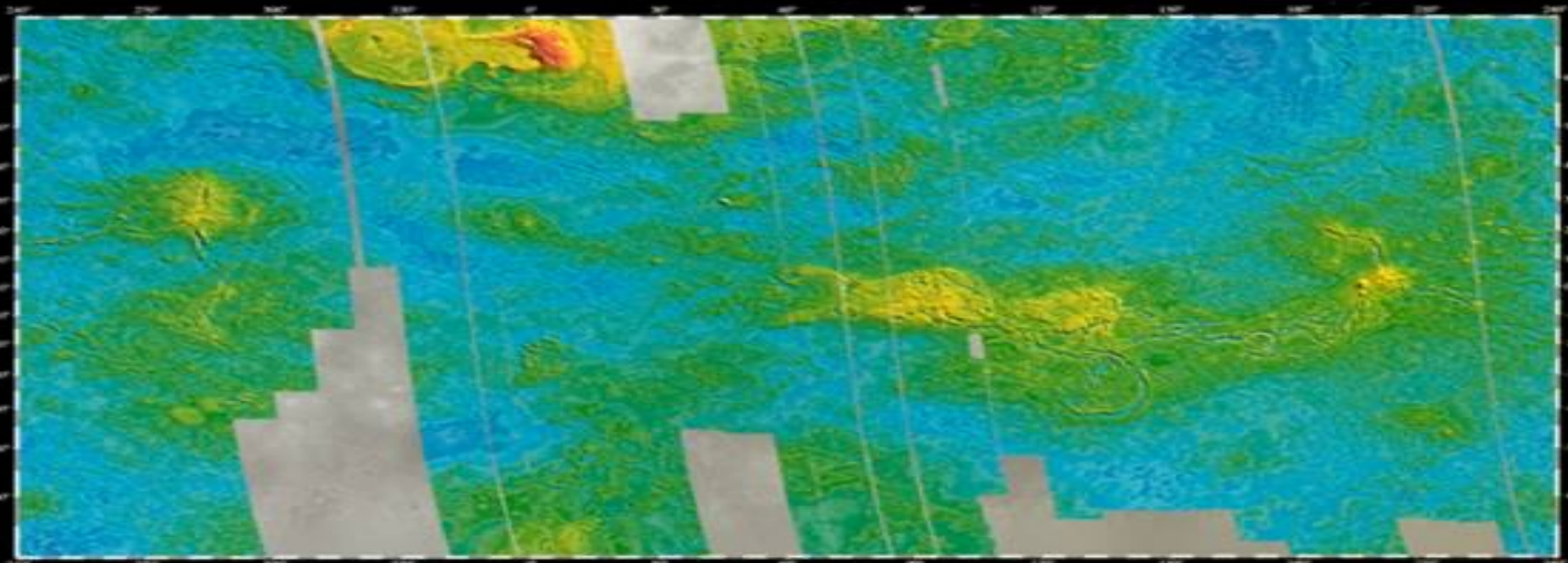
Mars = 0.59

Gliese 581d = 0.43

MAGELLAN

VENUS TOPOGRAPHY

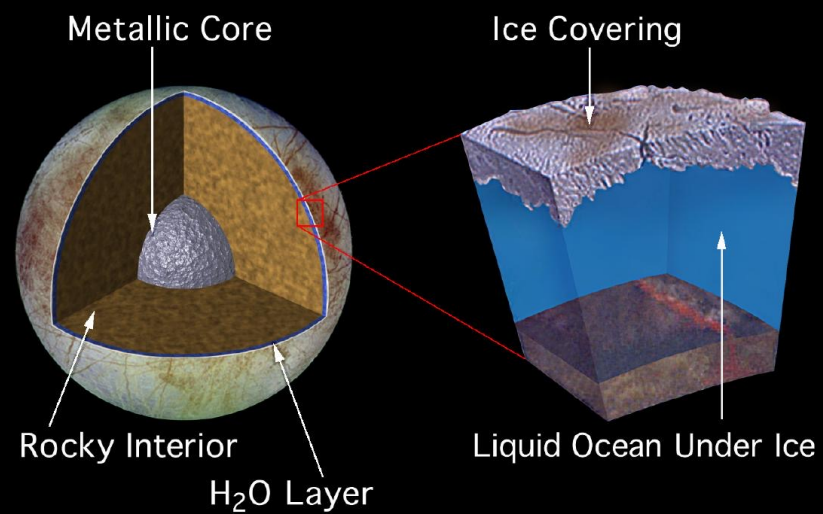
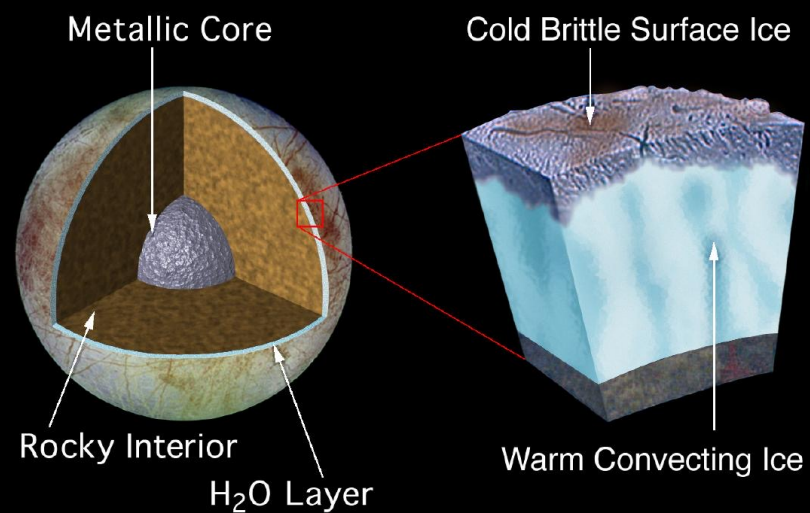
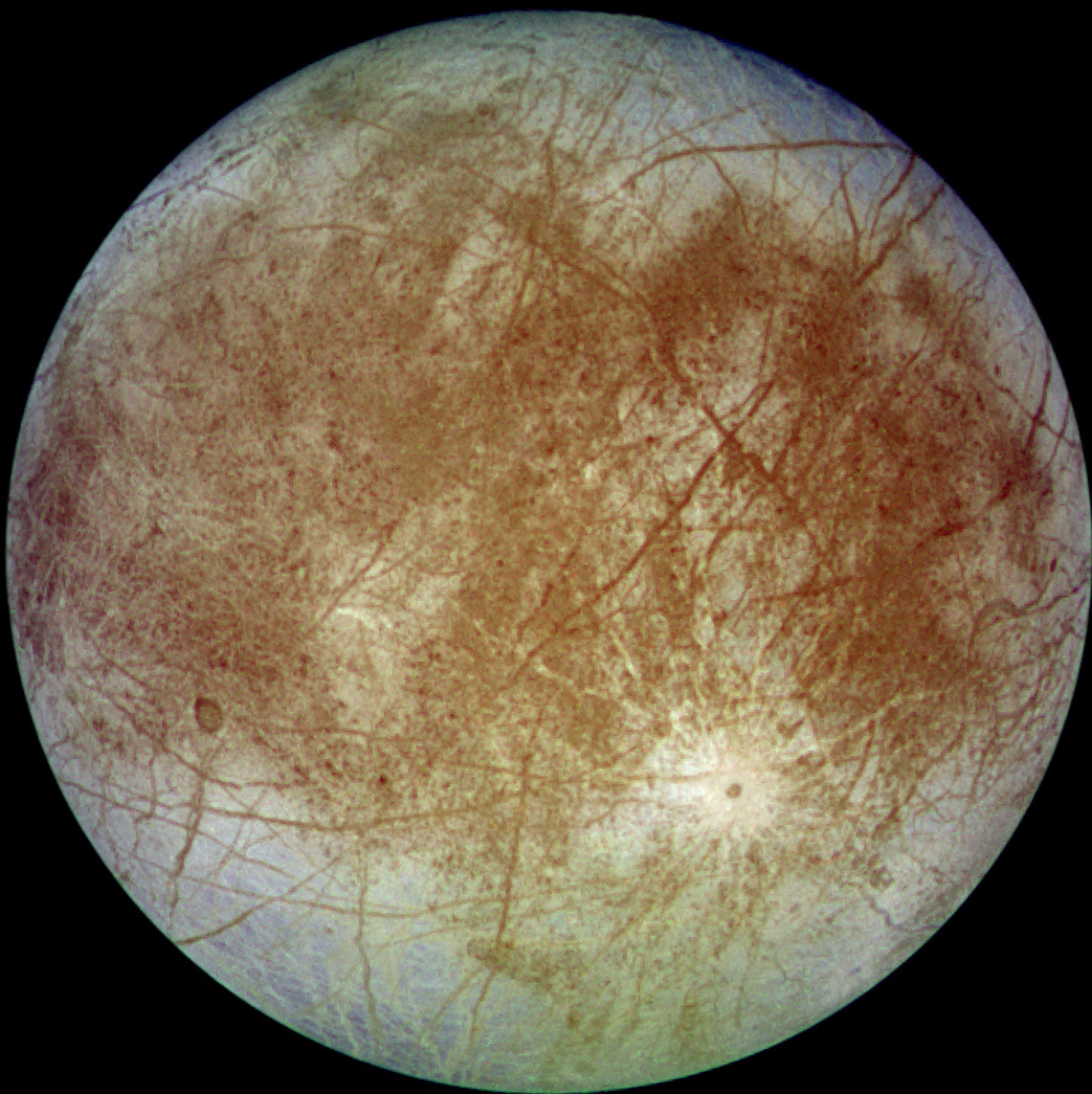
GTDRP.1;3

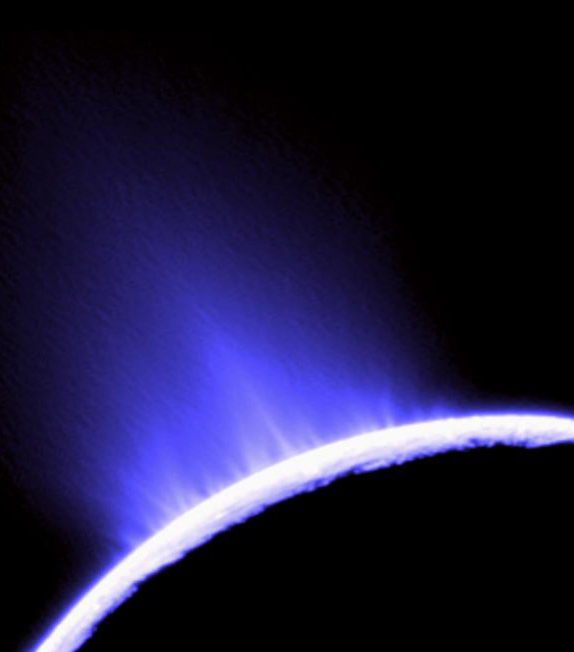
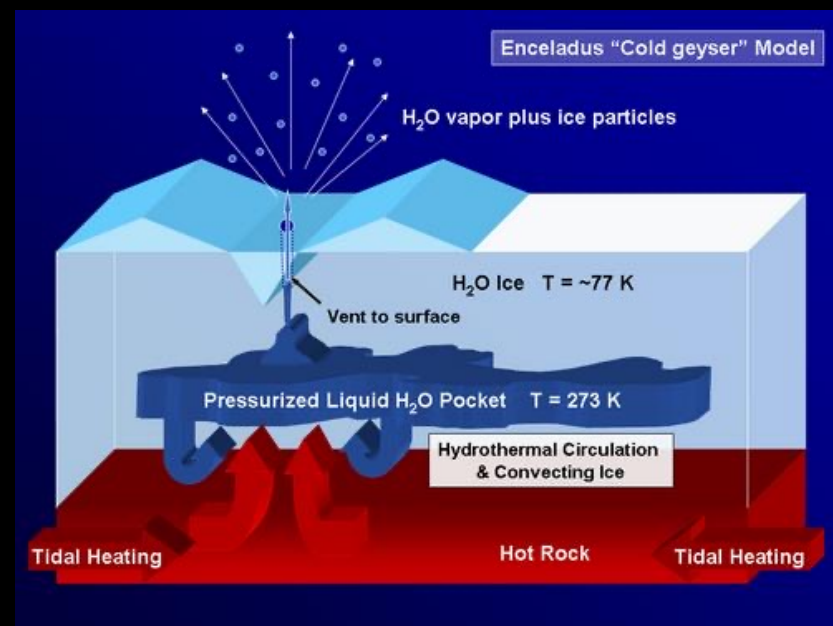
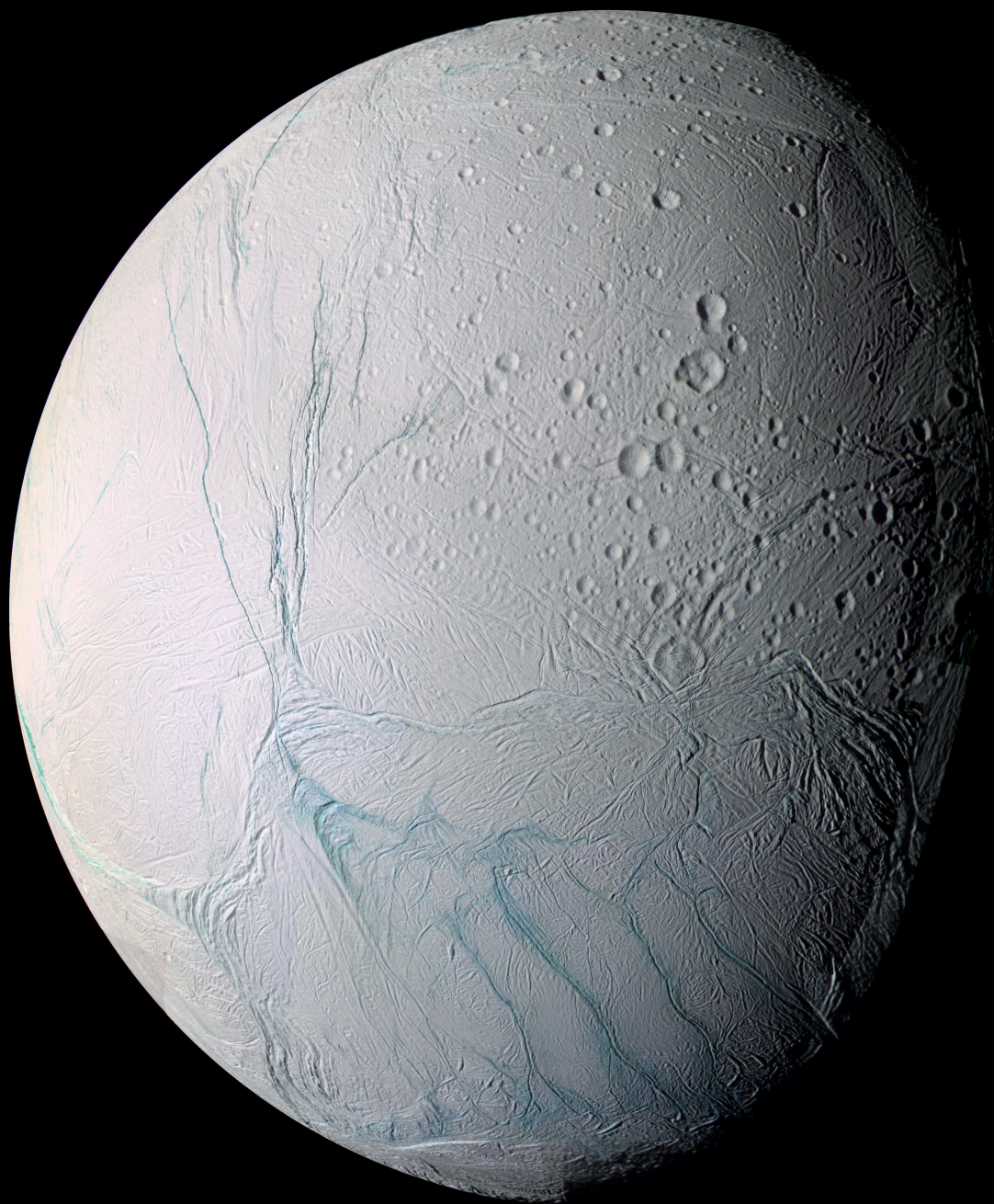


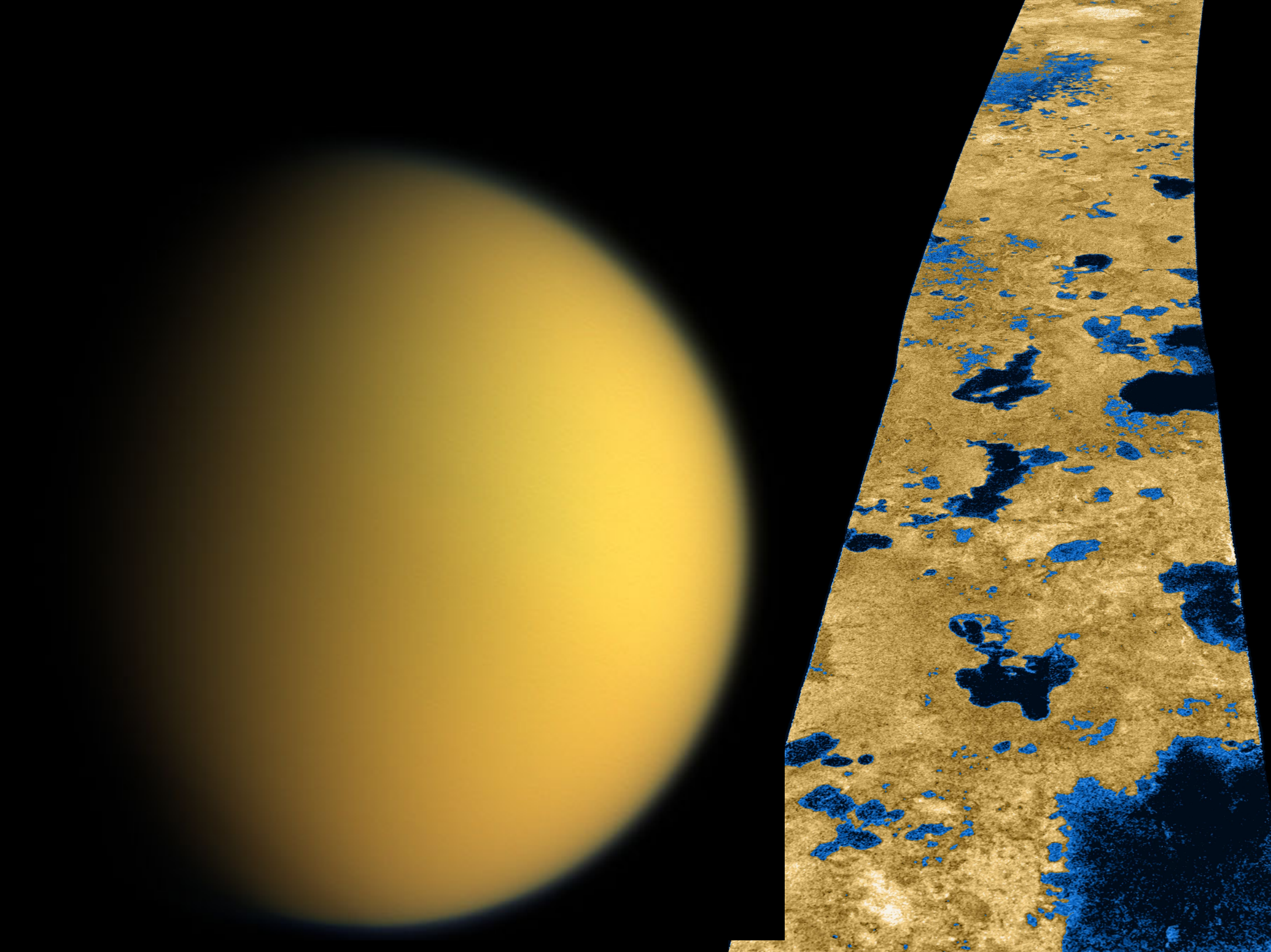
PRODUCT ID:	GTDRP.1;3	PRODUCTION DATE:	11/02/91
STARTING ORBIT:	376	PRODUCTION TIME:	13:19:13
ENDING ORBIT:	2586	HARDWARE VERSION:	01
PIXEL SIZE:	5x5 km	SOFTWARE VERSION:	02

Early View of Venus









Huygens Landing Site

Landed January 14, 2005 at 10.2S,
192.4W

Discovered small “rocks”, possibly made
of water ice, at the landing site.

Fluvial activity (methane?)

Images taken during descent showed no
open areas of liquid, but indicated liquid
had once flowed

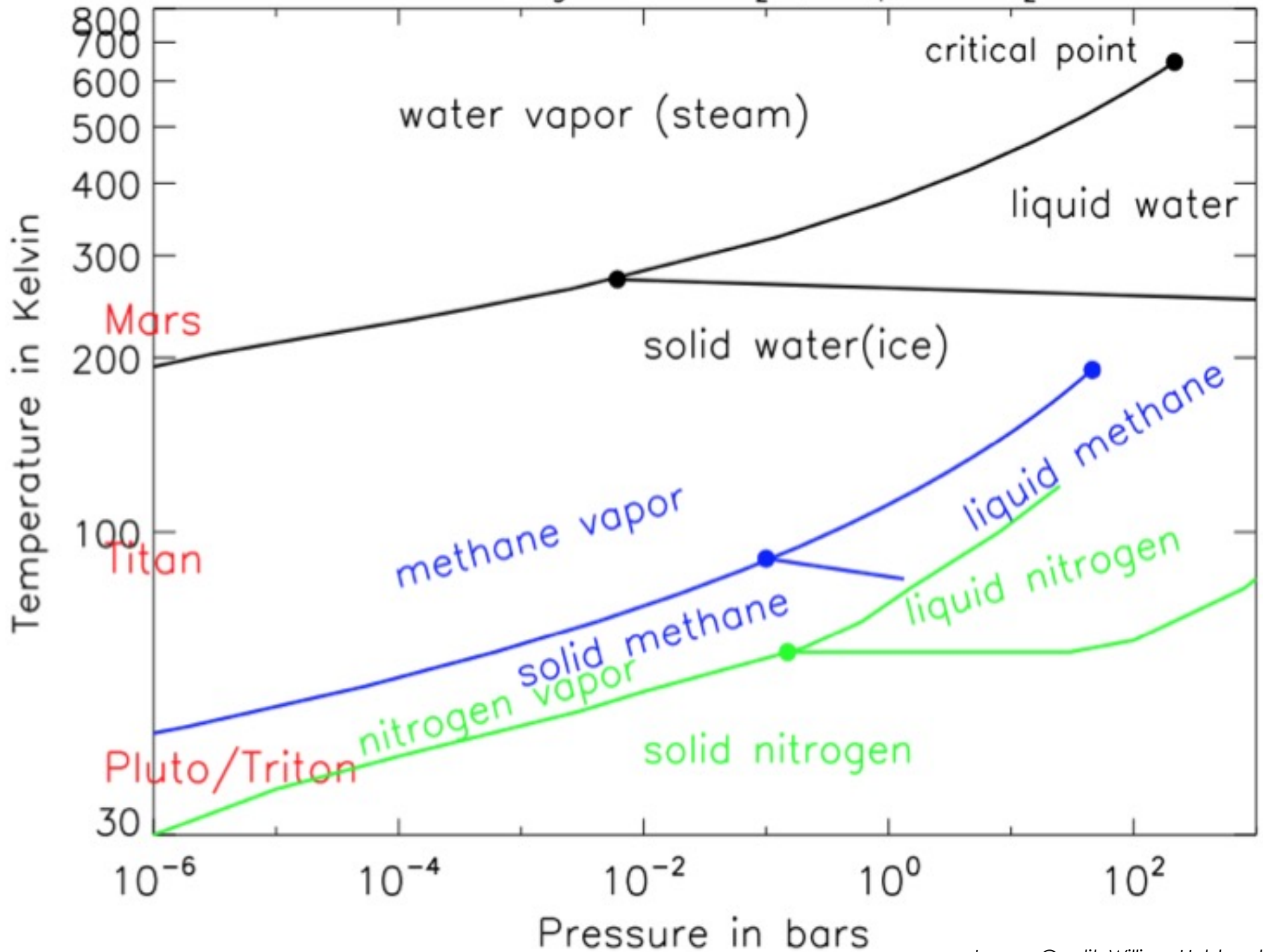


Titan

Earth



Phase diagrams of H_2O , CH_4 , and N_2



The Drake Equation

How many civilizations are out there?

Drake Equation

$$N = R \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

R average rate of star formation

f_p fraction of good stars that have planetary systems

n_e number of planets around these stars within an "ecoshell"

f_l fraction of those planets where life develops

f_i fraction of beings that develop intelligence

f_c fraction of intelligent beings that develop communications technology

L lifetime of the communicating phase

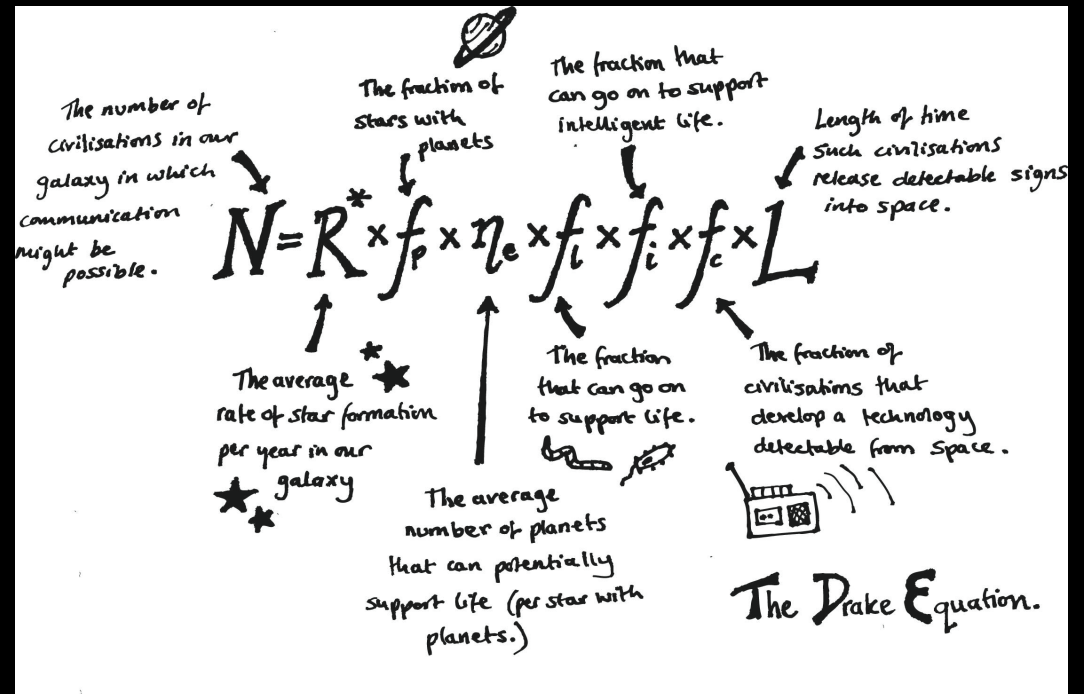
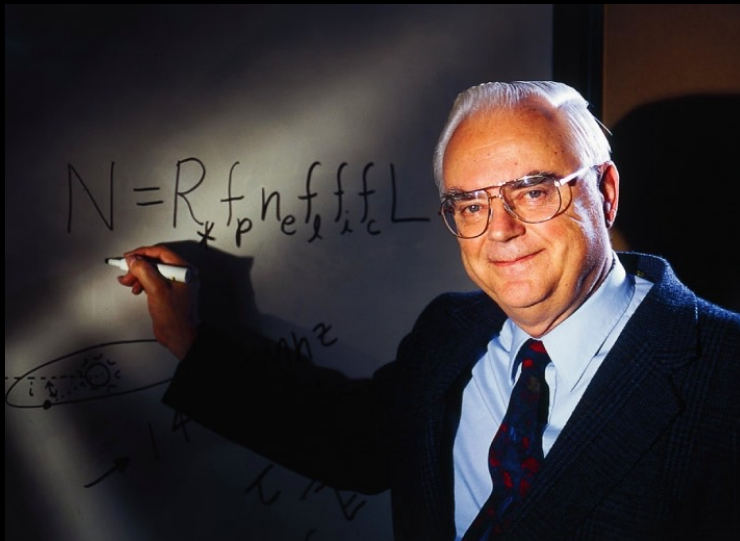






Figure 1. The "Wow!" signal. It was recorded on a computer printout of radio noise intensity from 50 frequency channels (digits and letters at left) at varying sky positions. (Photo: Courtesy Robert Dixon, Ohio State University Radio Observatory.)

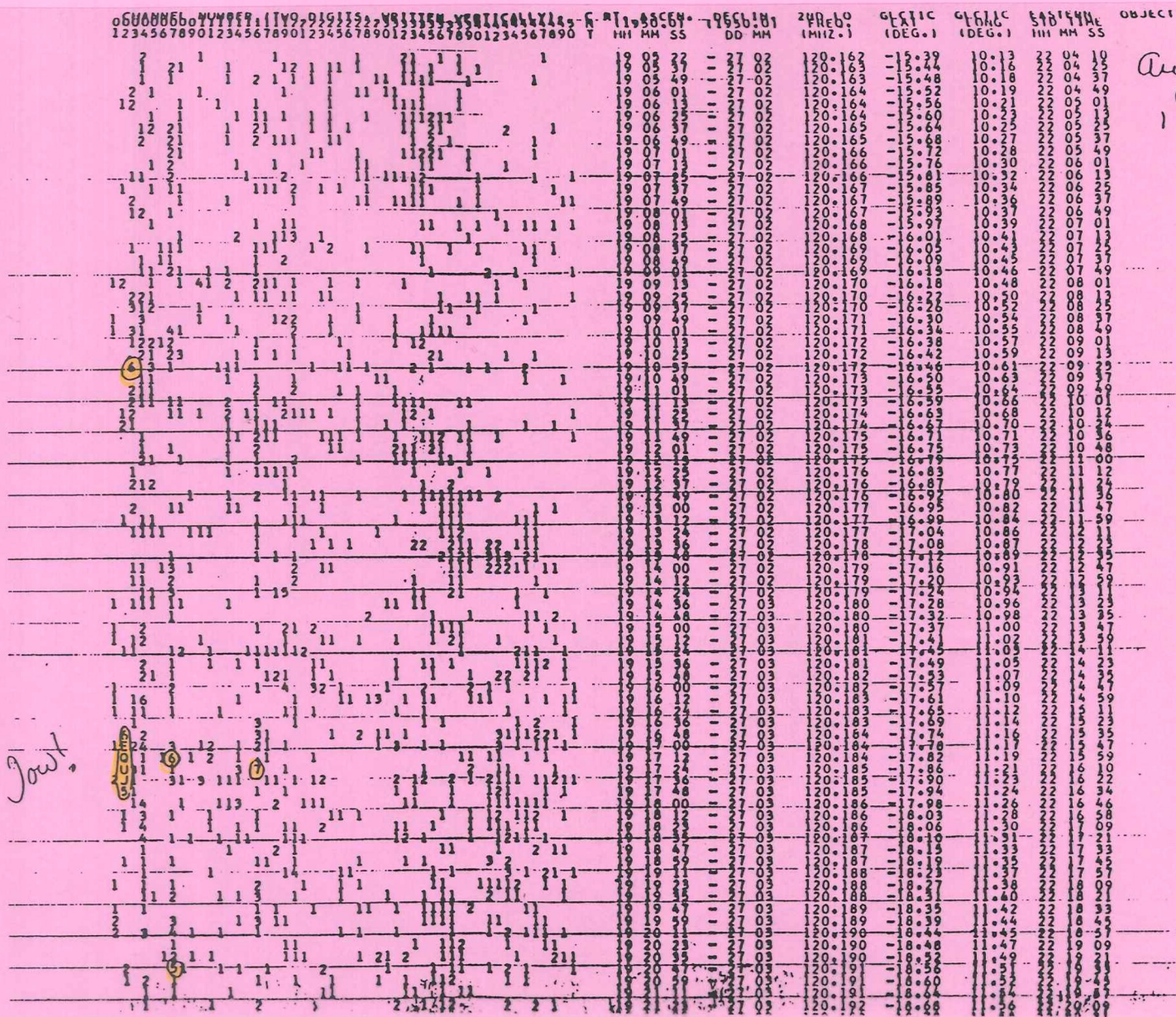
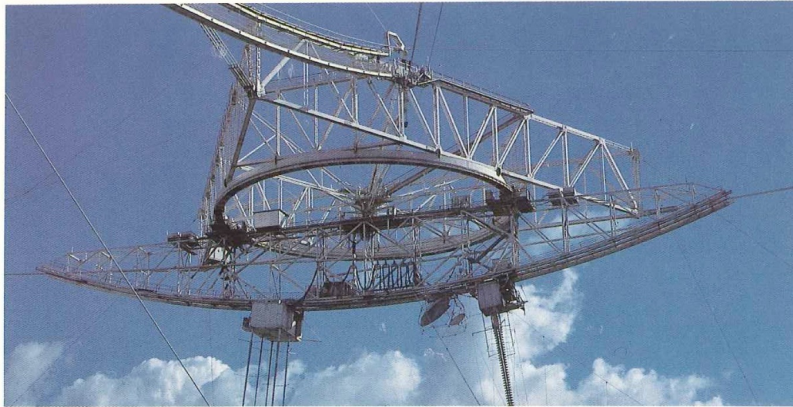


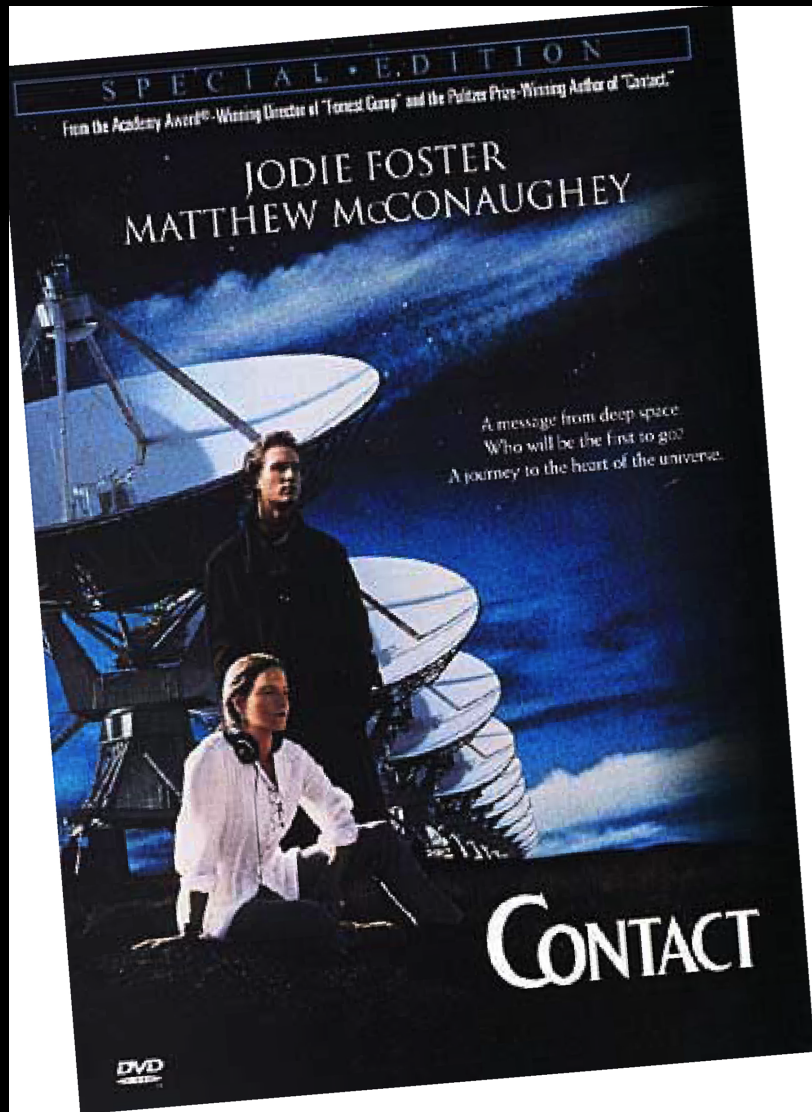
Figure 1

ARECIBO OBSERVATORY
ARECIBO, PUERTO RICO

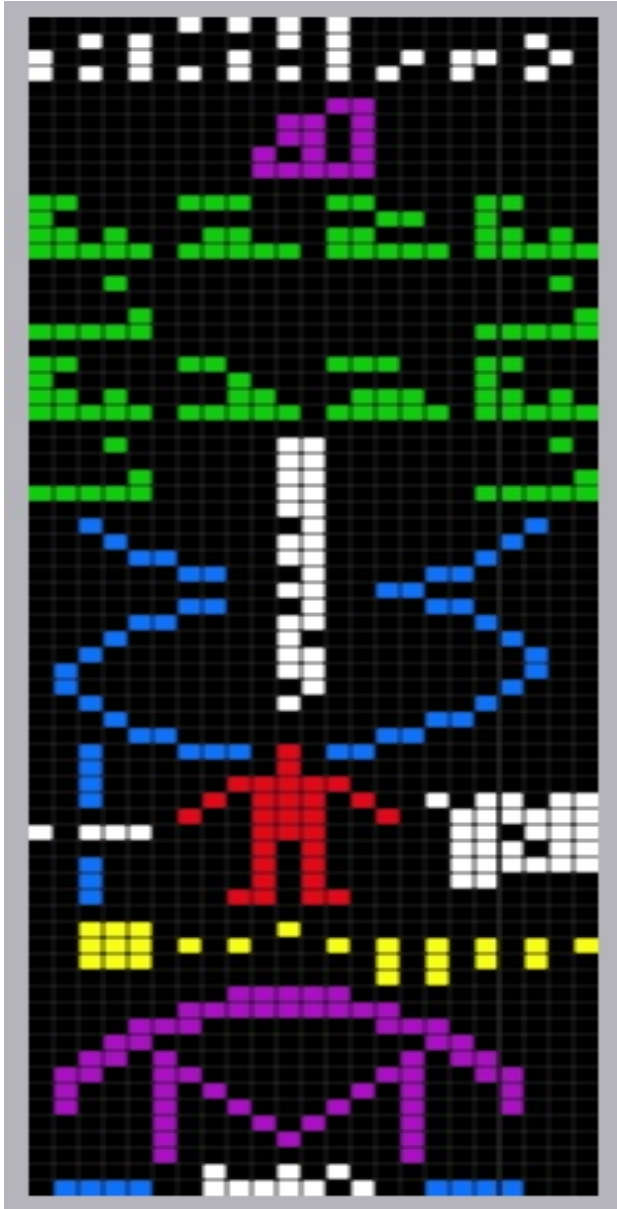


NATIONAL ASTRONOMY
AND IONOSPHERE CENTER
OPERATED BY CORNELL UNIVERSITY
UNDER COOPERATIVE AGREEMENT
WITH THE
NATIONAL SCIENCE FOUNDATION





Arecibo Message

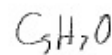


Broadcast on November 16th 1974
from the Arecibo radio telescope.

Aimed toward globular star cluster
M13.

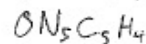
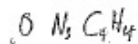
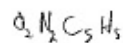
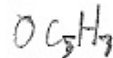
M13 is 25,000 light years away.

(Frank Drake)

Chaz
Vukotic

$1679 = 73 \times 23 \text{ (both primes)}$

$10 \text{ bits per sec} = 3 \text{ min}$

111
3

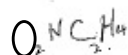
23 44



1057

2255

3

1 H
6 C
7 N
8 O
15 P

Adenine

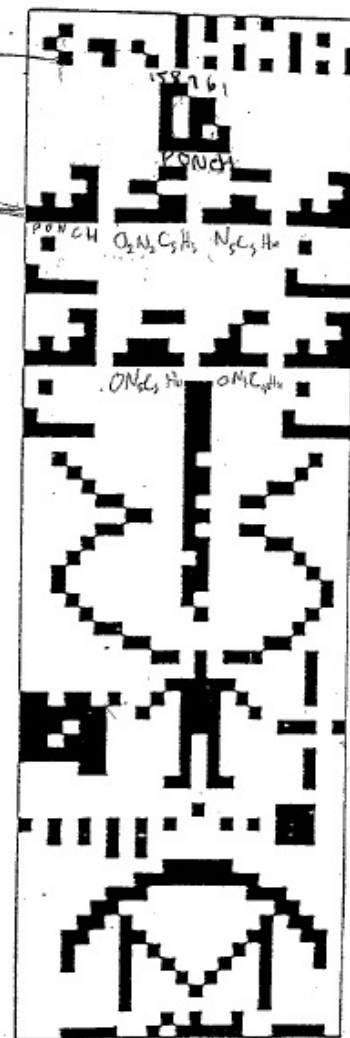
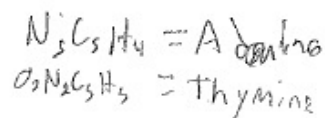
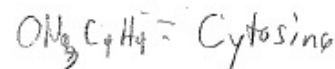
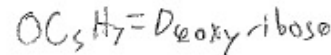
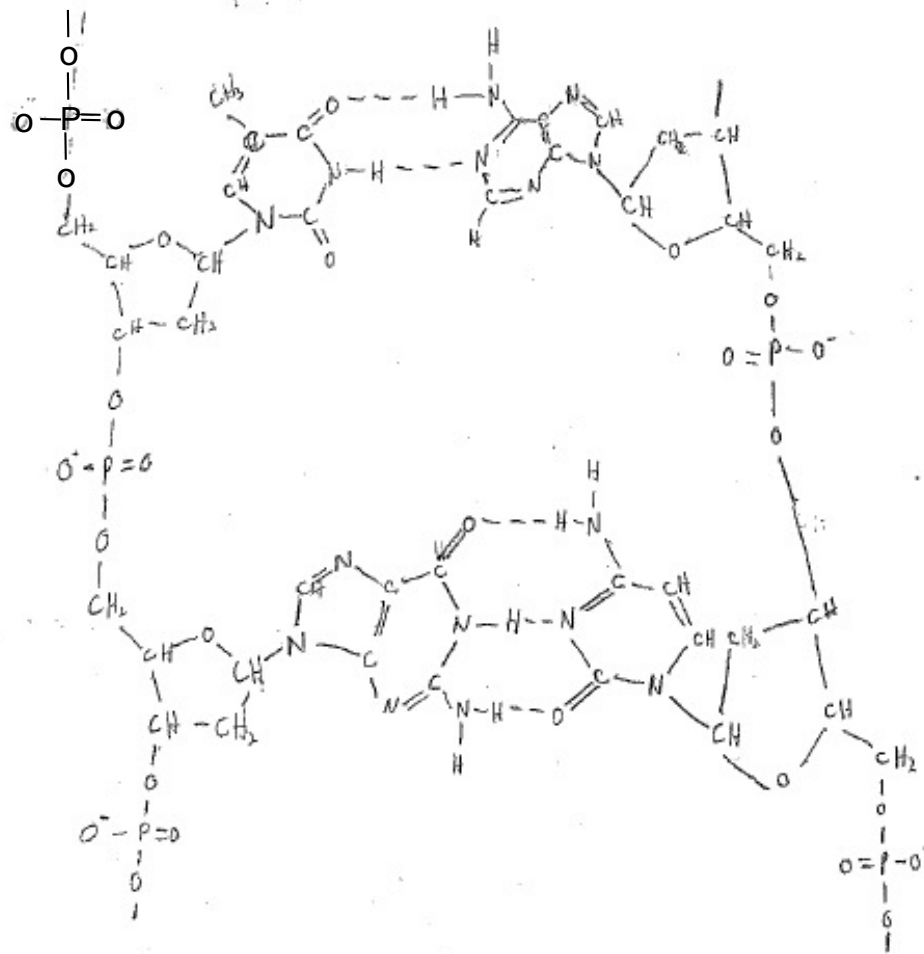
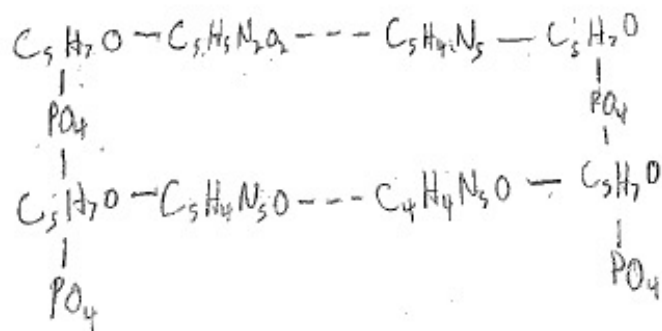


FIGURE 8.10. Diagram of the Arecibo radio message transmitted toward the Great Cluster in the constellation (1974).




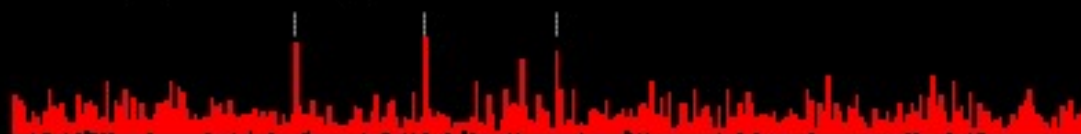


2 sets of
base pairs
whole of
human
genome.



Data Analysis

Computing Fast Fourier Transform 87% 
Doppler drift rate: -19.4612 Hz/sec Resolution: 0.149 Hz
Best Triplet: power 9.33, period 0.7275



Overall: 93.929% done

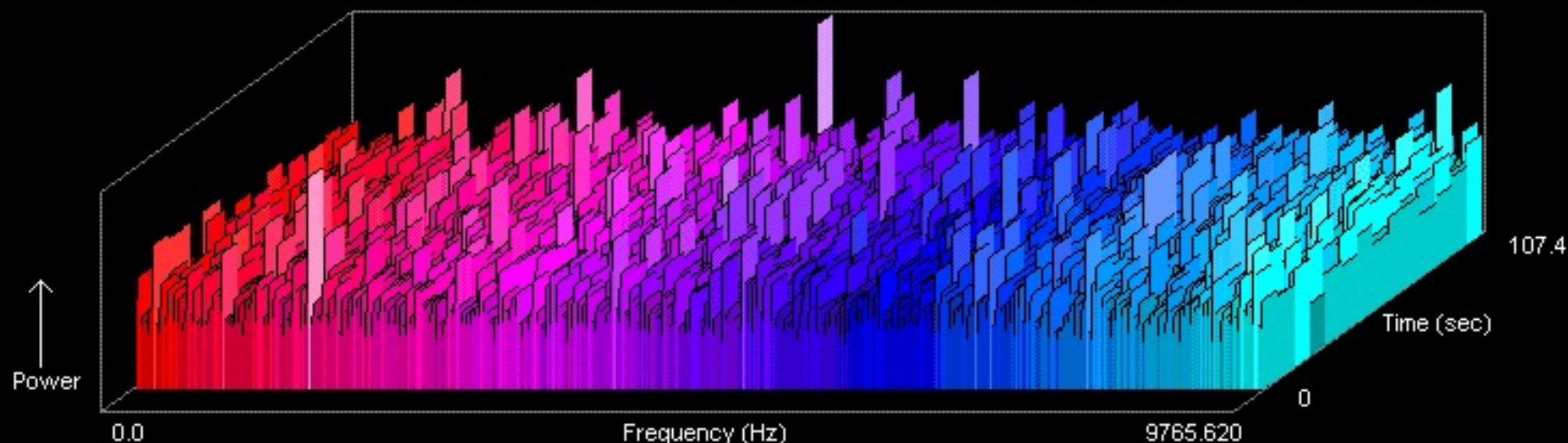
CPU time: 8 hr 28 min 41.1 sec

Data Info

From: 18 hr 45' 17" RA, +13 deg 0' 36" Dec
Recorded on: Wed Mar 07 12:47:29 2001 GMT
Source: Arecibo Radio Observatory
Base Frequency: 1.419707031 GHz

User Info

Name: Alan M. MacRobert
Data units completed: 197
Total computer time: 6327 hr 20 min 01.5 sec





ATA - Allen Telescope Array

C H A R L I E S H E E N

The greatest danger

facing our world

has been the planet's

best kept secret...

until now.

T H E A R R I V A L





Kepler Mission: *A search for habitable planets.*



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Launch of the Kepler Spacecraft

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(best for PCs)

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**SUCCESSFUL
LAUNCH:**
2009 March 6 at
10:49 pm EST.

[Media from
Kennedy Space
Center \(KSC\)](#)

[Press
Conference
Media
Resources](#)
Full [Press Kit](#)
(3 Mb pdf)

[Mission
Manager's
Updates](#)

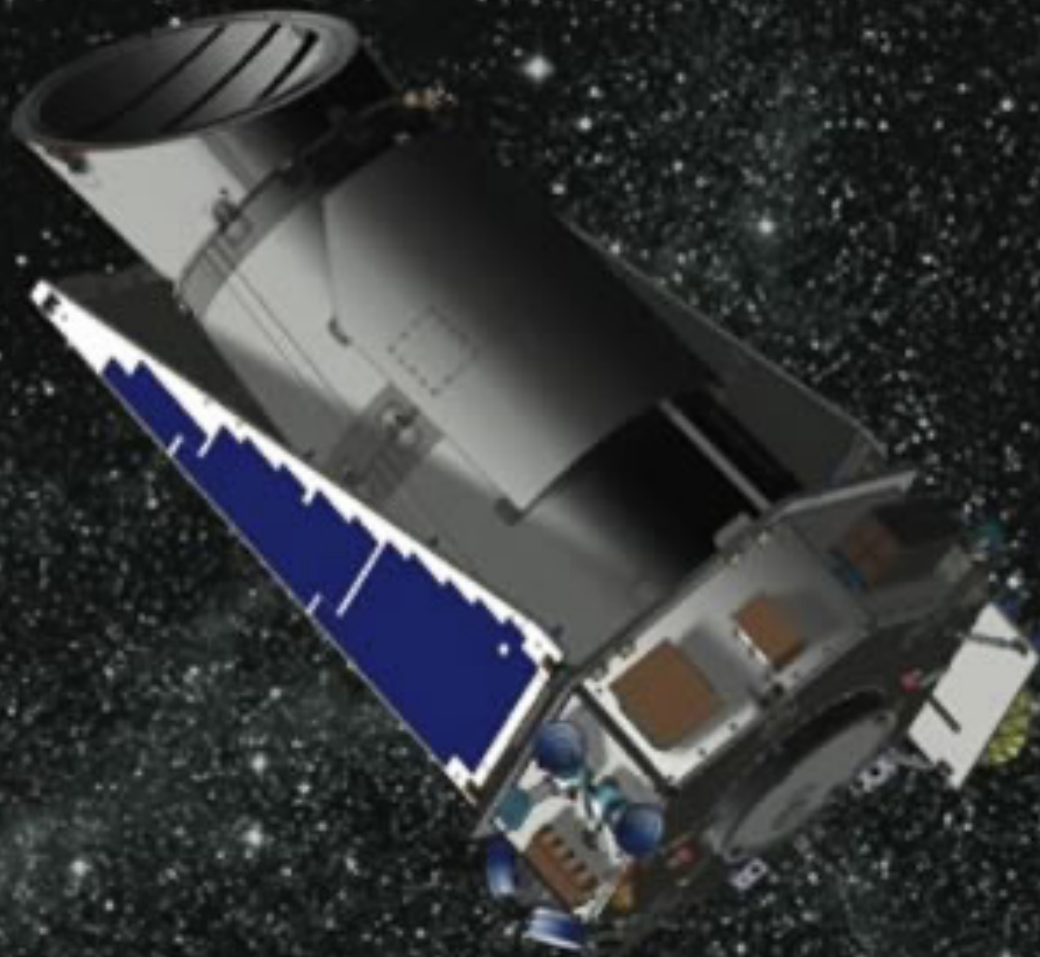
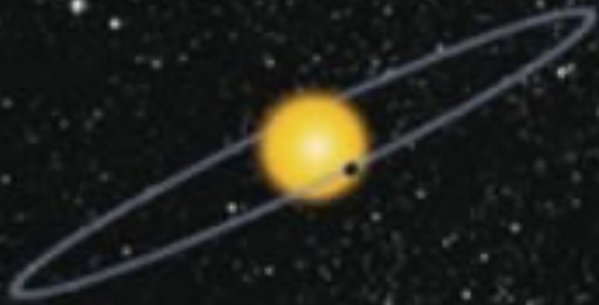
[NASA Kepler
webcasts](#)



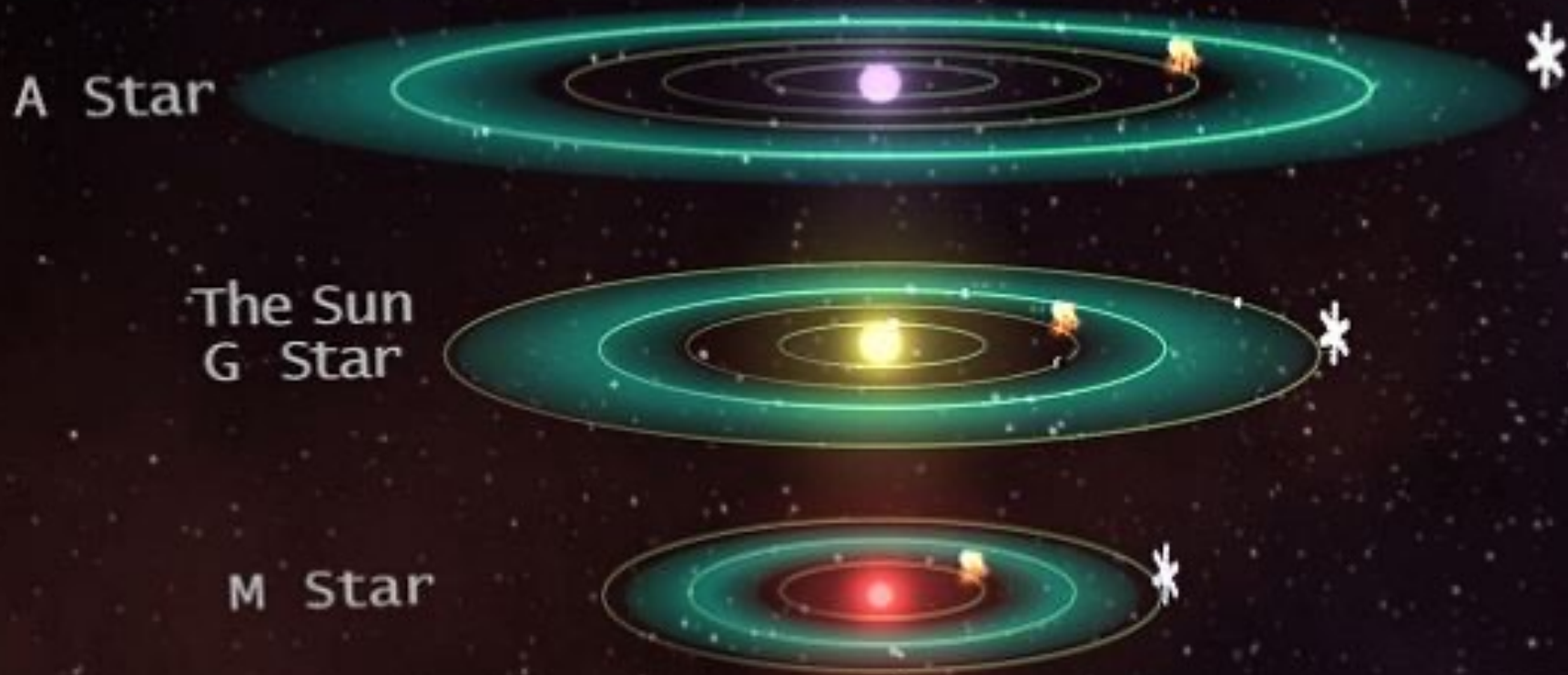
Photo below by Ben
Cooper
<http://www.launchphotography.com>;
originally posted at <http://apod.nasa.gov/apod/ap090309.html>

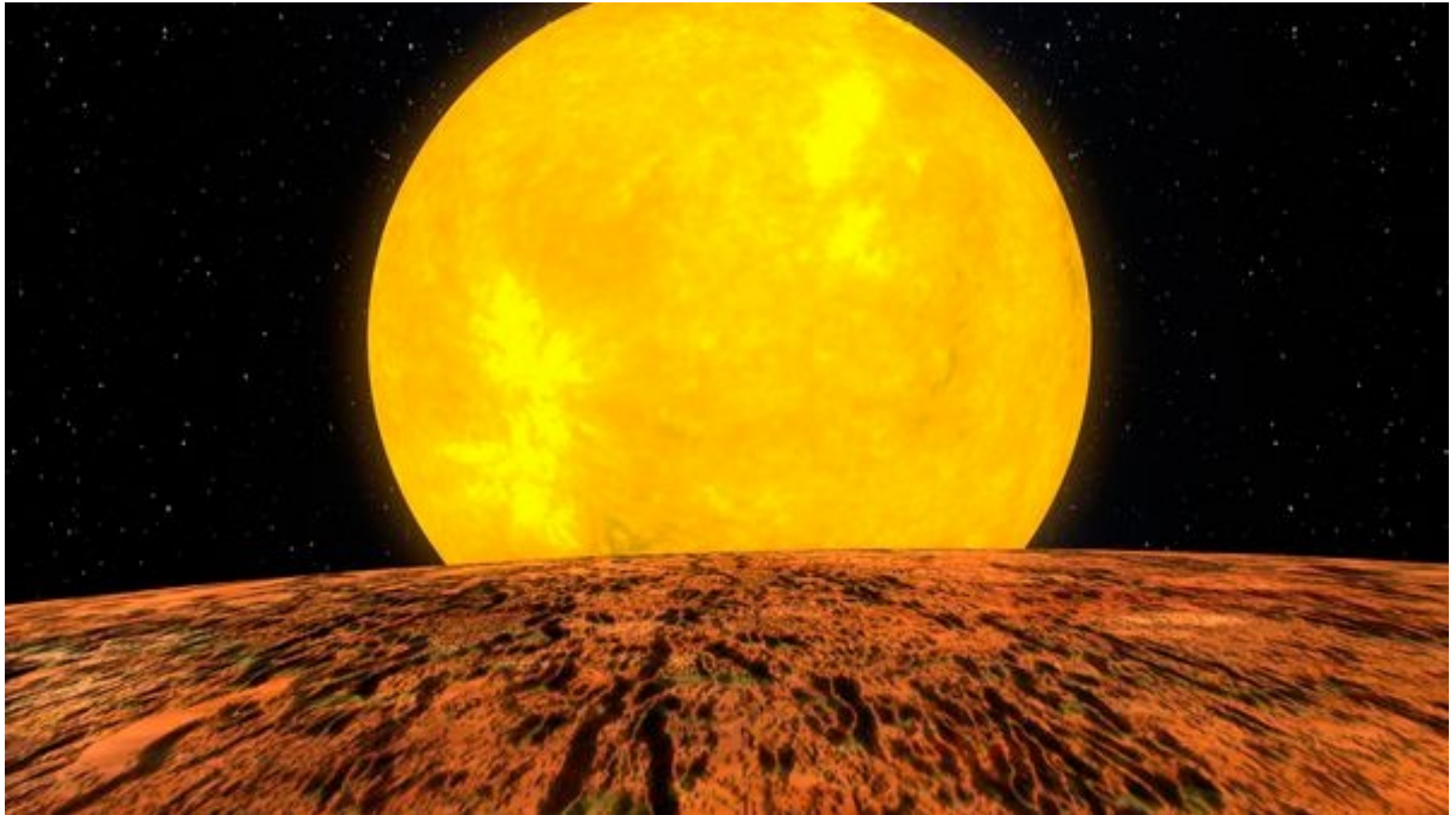


Kepler



Life Around Other Stars





Imagined View from Planet Kepler-10b (Artist's Depiction)
Credit: NASA/Kepler Mission/Dana Berry

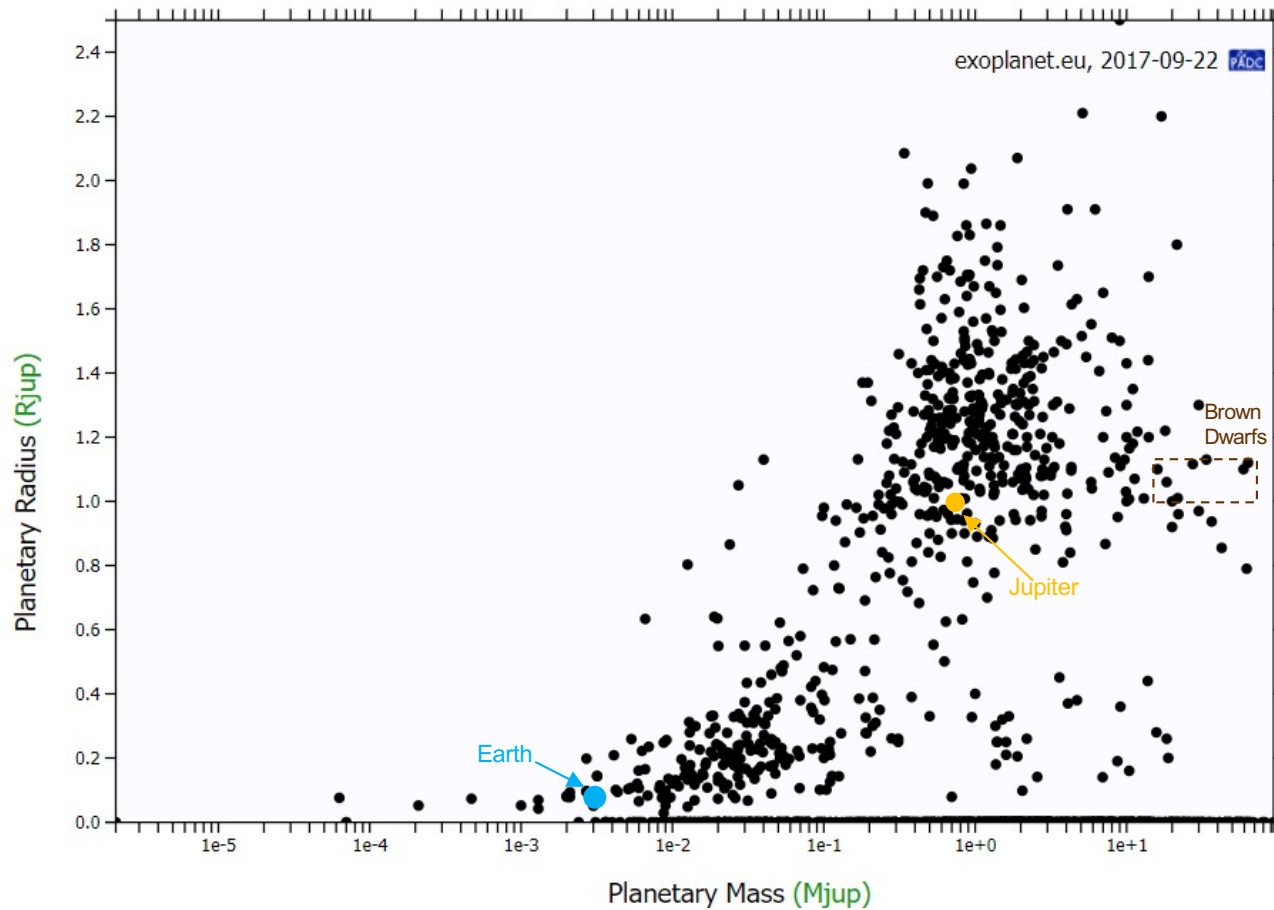
Diagrams: scatter plot

[Histogram plot →](#)

Status ▾

Detection ▾

"confirmed" in planet_status



X axis

Planetary Mass ▾

☐ show error bars☒ log scale

min

max

Y axis

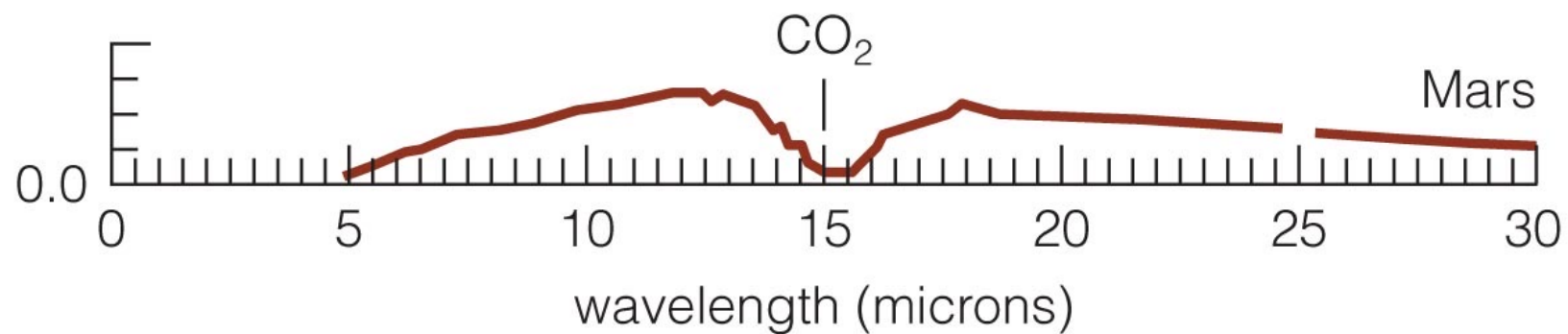
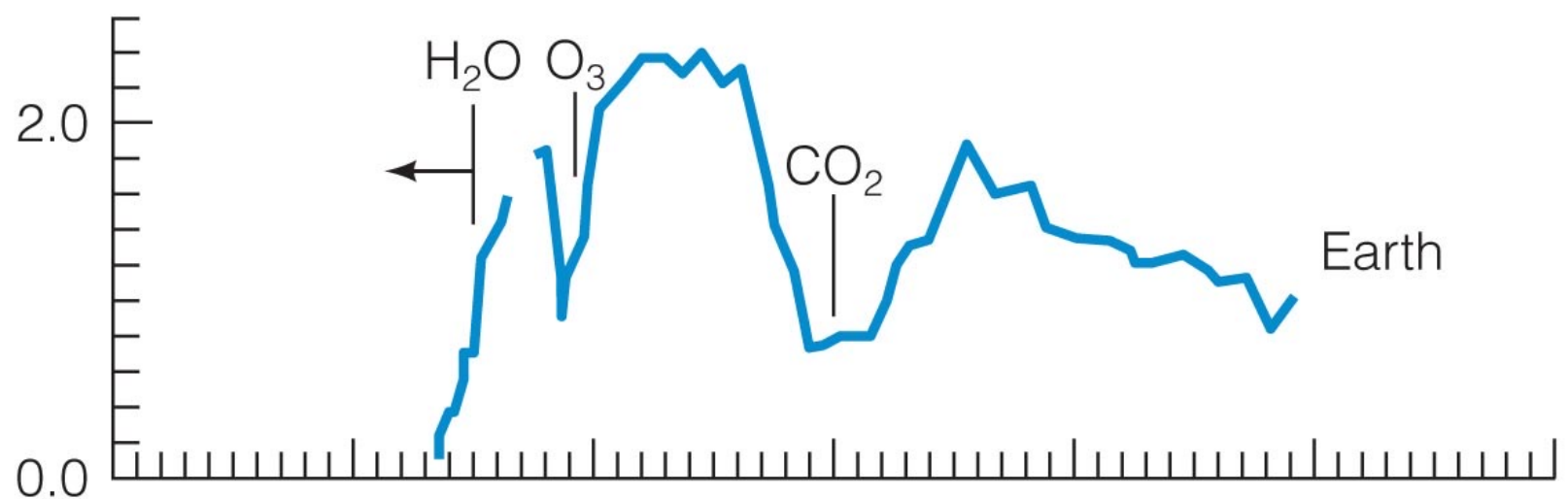
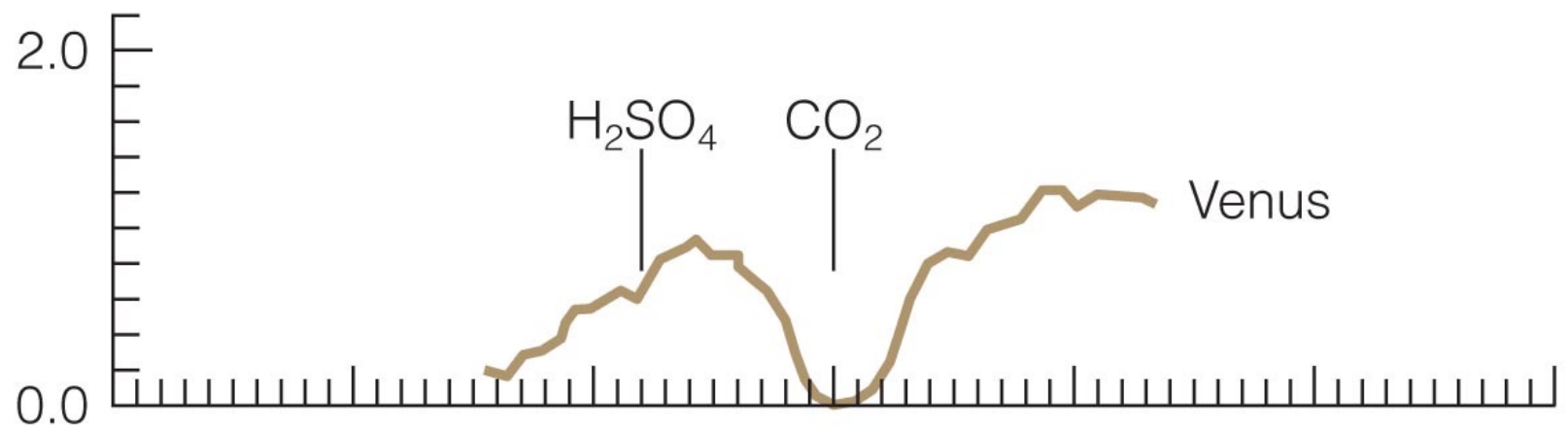
Planetary Radius ▾

☐ show error bars☐ log scale

min

max

Color ☐Size ☐☐ Set grid☐ Manual Pan/Zoom☐ Set labels☐ Selection mode



In Disasters, Panic Is Rare; Altruism Dominates

ScienceDaily (Aug. 8, 2002) — WASHINGTON, DC — Group panic and irrational behavior did not occur at the World Trade Center on September 11, 2001. Instead the event created a sense of "we-ness" among those threatened, says Rutgers University sociology professor Lee Clarke. In his article, "Panic: Myth or Reality?", in the fall 2002 edition of *Contexts* magazine, he explains that 50 years of evidence on disasters and extreme situations shows that panic is rare, even when people feel "excessive fear."

Rarity of Panic

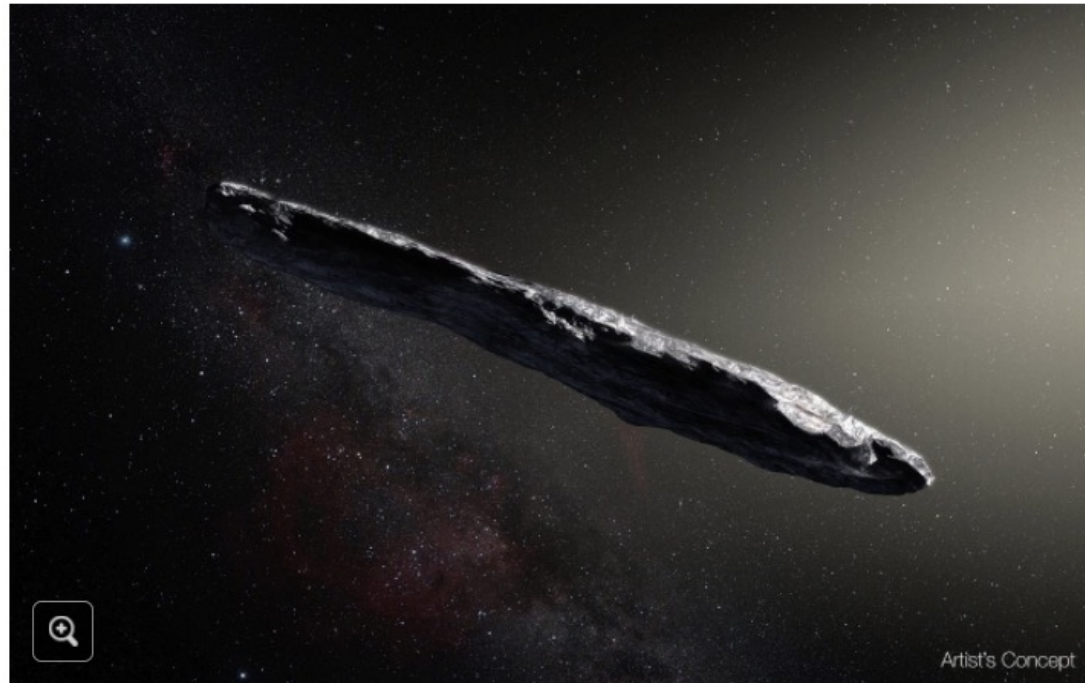
Because this combination of conditions is so uncommon in disasters, panic is also quite rare. (6, 7) When panic does occur, it usually involves few persons, is short-lived, and is not contagious. (21) In studies of more than 500 events, the University of Delaware's Disaster Research Center found that panic was of very little practical or operational importance. (21, 22) A number of systematic studies of human behavior in disasters have failed to support news accounts of widespread panic. (5, 8, 23–26)



THE ORIGINAL INVASION!

THE WAR OF THE WORLDS

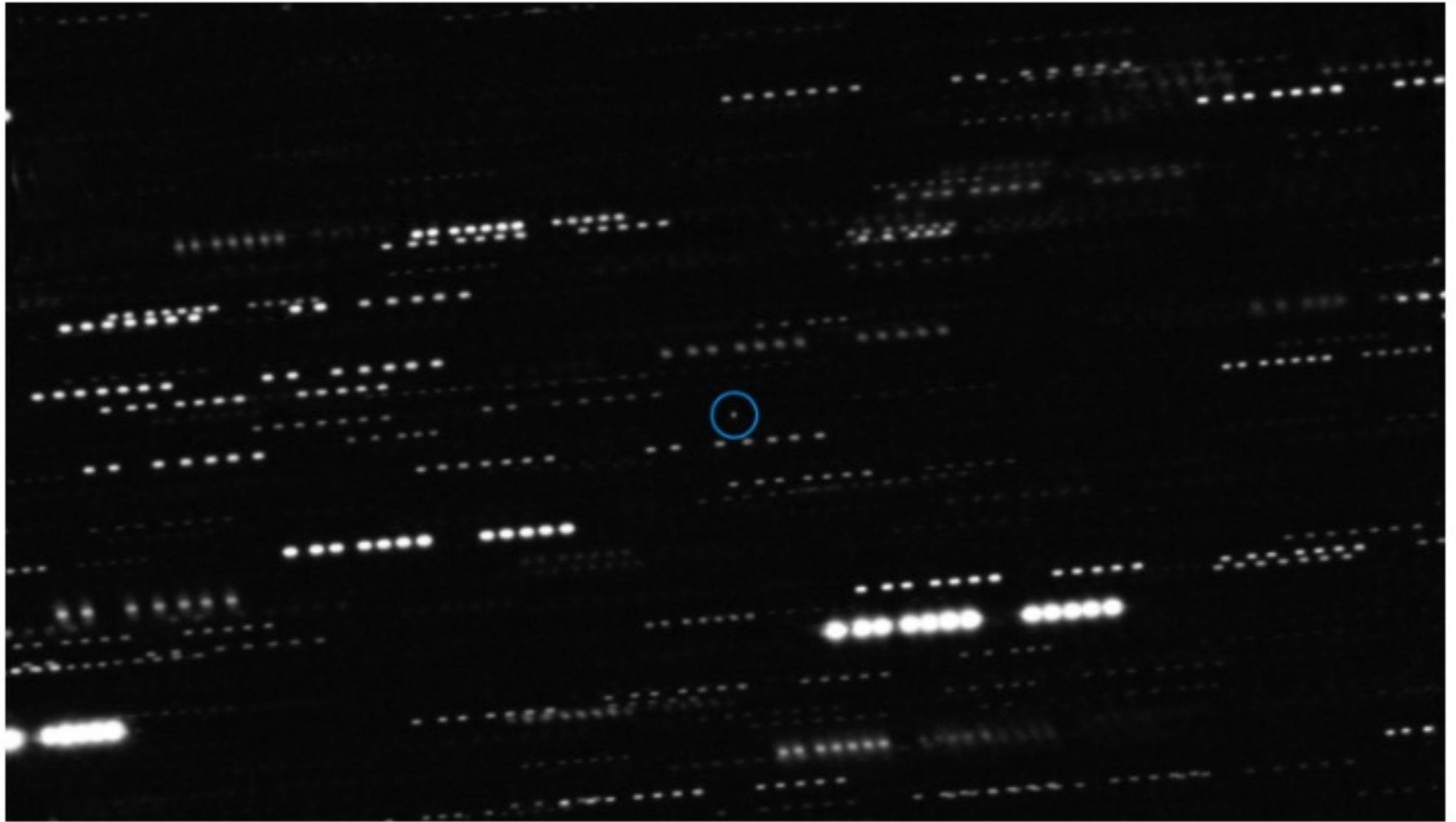




Artist's concept of interstellar object 1I/2017 U1 ('Oumuamua) as it passed through the solar system after its discovery in October 2017. The aspect ratio of up to 10:1 is unlike that of any object seen in our own solar system. Image Credit: European Southern Observatory / M. Kornmesser



Originally classified as an asteroid, Oumuamua is an object estimated to be about 230 by 35 meters (800 ft x 100 ft) in size, travelling through our solar system. (Getty Images/Aunt_Spray)



This very deep combined image shows the interstellar object 'Oumuamua at the center of the image. It is surrounded by the trails of faint stars that are smeared as the telescopes tracked the moving comet.

Credit: ESO/K. Meech et al.