Фермијев парадокс
или
Зашто нема ванземаљаца?

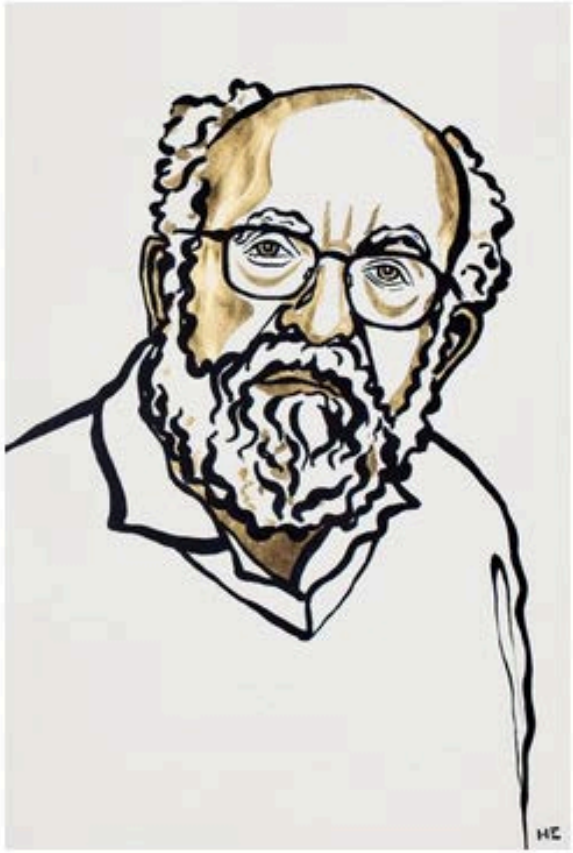
Н. Швракић

The Nobel Prize in Physics 2019

Ill. Niklas Elmehed. © Nobel Media.

James Peebles

Prize share: 1/2



Ill. Niklas Elmehed. © Nobel Media.

Michel Mayor

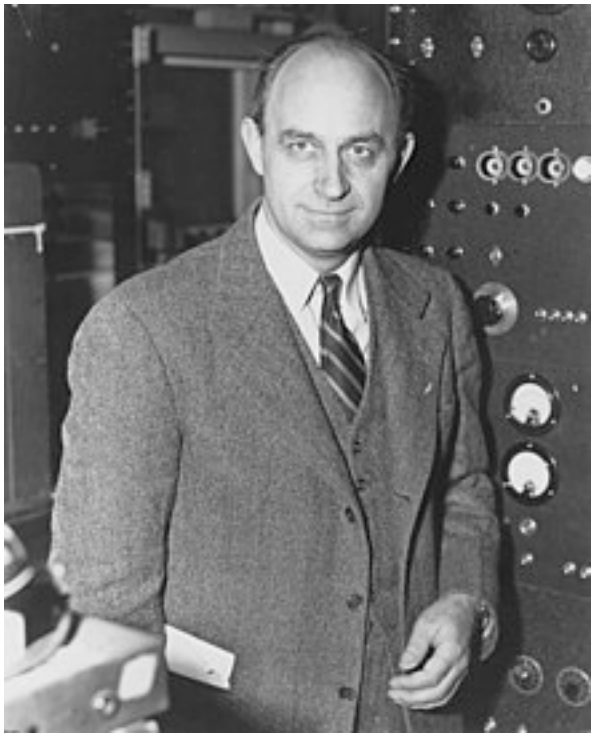
Prize share: 1/4

Ill. Niklas Elmehed. © Nobel Media.

Didier Queloz

Prize share: 1/4

The Nobel Prize in Physics 2019 was awarded "for contributions to our understanding of the evolution of the universe and Earth's place in the cosmos" with one half to James Peebles "for theoretical discoveries in physical cosmology", the other half jointly to Michel Mayor and Didier Queloz "for the discovery of an exoplanet orbiting a solar-type star."



Енрико Ферми 1901-1954


FERMI PARADOX
WHERE ARE THEY?

MUSINGS ON THE PROBABILITY OF ALIEN LIFE EXISTING SOMEWHERE IN THE UNIVERSE:

THERE ARE TRILLIONS OF GALAXIES

IN THE OBSERVABLE UNIVERSE

.. EACH WITH BILLIONS OF STARS

SURELY SOME OF THEM HARBOR LIFE

OUR GALAXY ALONE HAS 400 BILLION!

YET STARS ARE OUTBUMBERED BY PLANETS...

IN FACT: THERE MAY BE 2 PLANETS PER STAR

OF THEM, 20 BILLION ARE "EARTH-LIKE"

AND LESS THAN 5,000 ARE KNOWN!

HOW CAN ANYONE EVER SAY WE ARE ALONE?

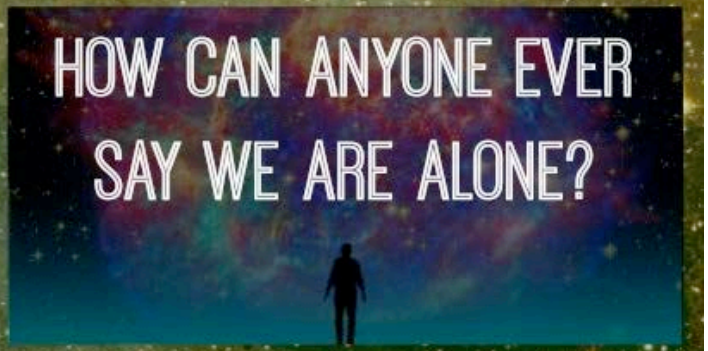
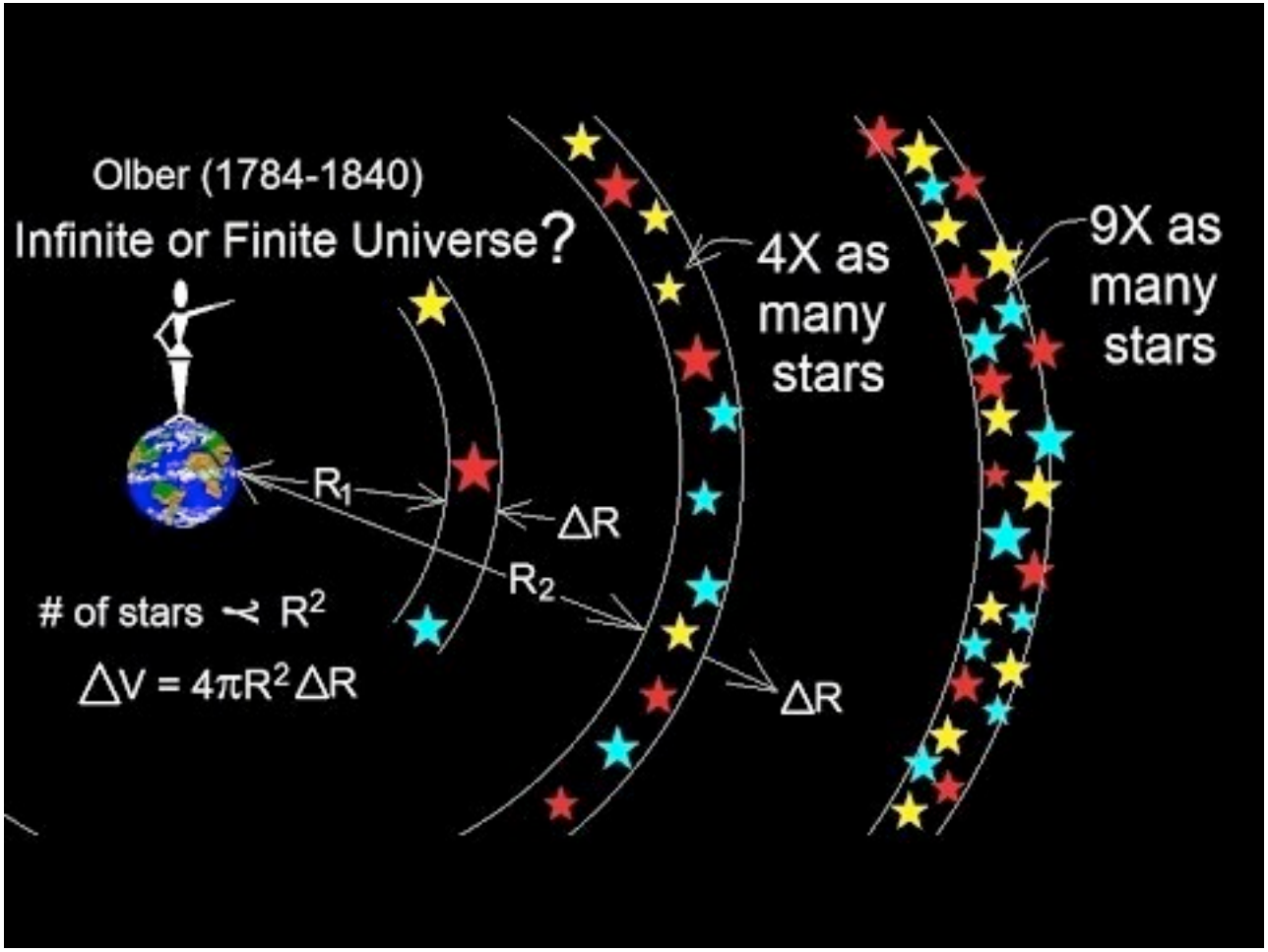


Image Credit: NASA (Top Left), Steve Mandel/John Gleason(Milky Way), Shutterstock (Center Right), Jon Lomberg (Bottom Left), NASA/JPL (Bottom Right)


Olber (1784-1840)
Infinite or Finite Universe?
4X as many stars
9X as many stars
R_1
R_2
ΔR
ΔR
# of stars $\propto R^2$
$\Delta V = 4\pi R^2 \Delta R$

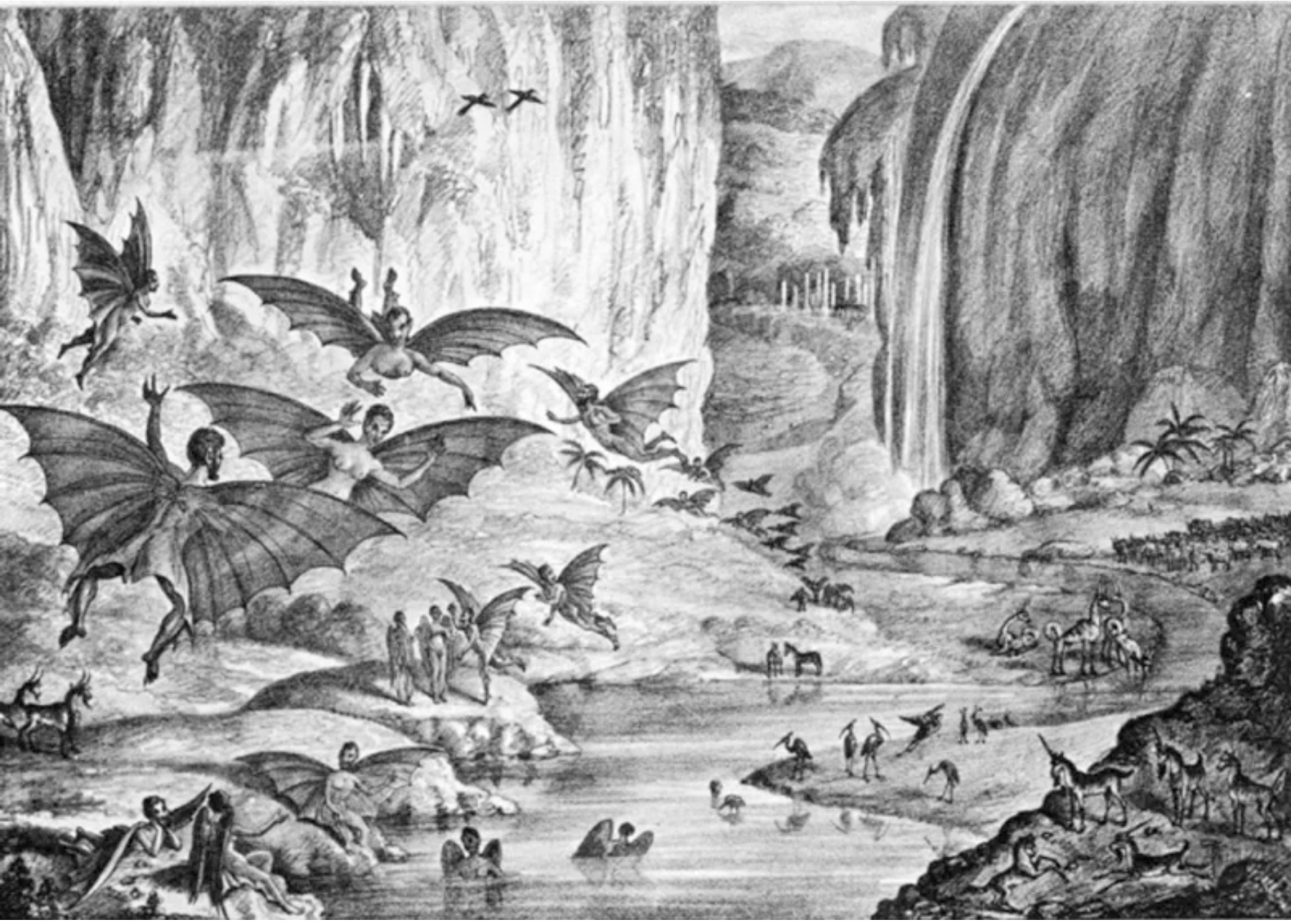
Ancient Aliens

Lunar inhabitants turn up surprisingly early in the canon of Western literature. In the seventh century BC, Thales of Miletus described the moon as a spherical body, much like the Earth, providing people who dreamed of non-human intelligent life a perfect platform for their imaginings. Some followers of the philosopher and mathematician Pythagoras, among them Philolaos, claimed that the moon was populated by animals and plants more beautiful than those on Earth. (The animals, notably, were 15 times more powerful and for some reason produced no excrement.) In Lucretius' first century BC poem De rerum natura, the Roman philosopher states that, given the expansive nature of the universe, it is likely that life is not unique to Earth, but must exist elsewhere in the cosmos.

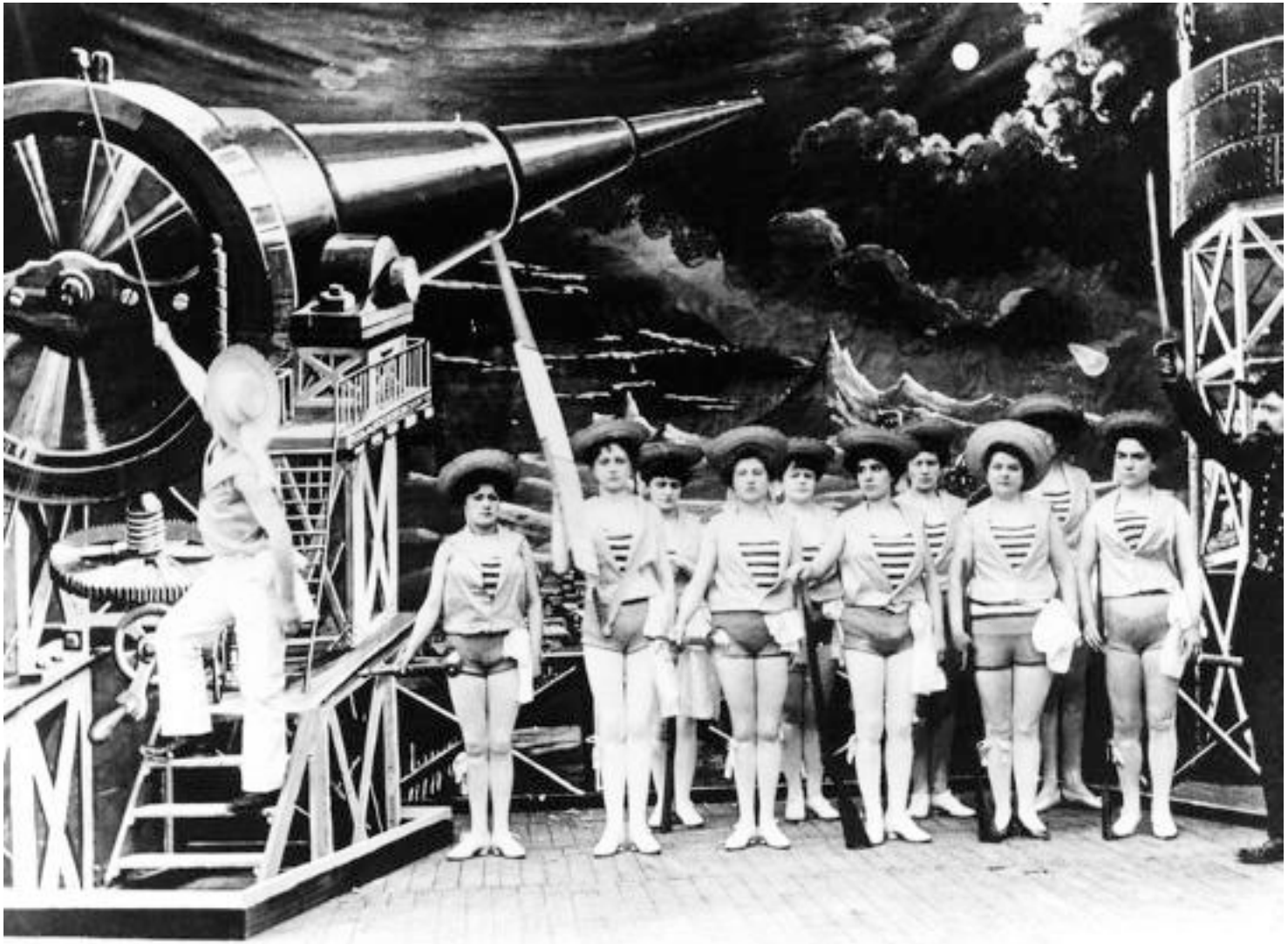
Famously, Lucianus of Samosata's satire True History appears on the scene around 177 AD and features a war between the denizens of the sun and the inhabitants of the moon. Of course, contrary to the title, Lucianus didn't actually believe in the existence of these particular aliens; he was just spoofing over-the-top travel tales and creating an ancient forerunner to science fiction in the process.

Velika obmana o Mesecu 1835.

Te godine, serija od šest tekstova je izašla u New York Sun pod naslovom
VELIKA ASTRONOMSKA OTKRIĆA SER DŽON HERŠELA na Rtu Dobre Nade,
s naznakom da su otkrića već objavljena
U Edinburškom Časopisu za Nauku. U radu se ističe da su, uz pomoć jakog teleskopa, astronomi otkrili život na Mesecu - I to ne samo život, već egzotičan život. U radu se pominje mesečev bizon, plave koze I, najčudnije, krilata ljudska bića I njihova civilizacija.

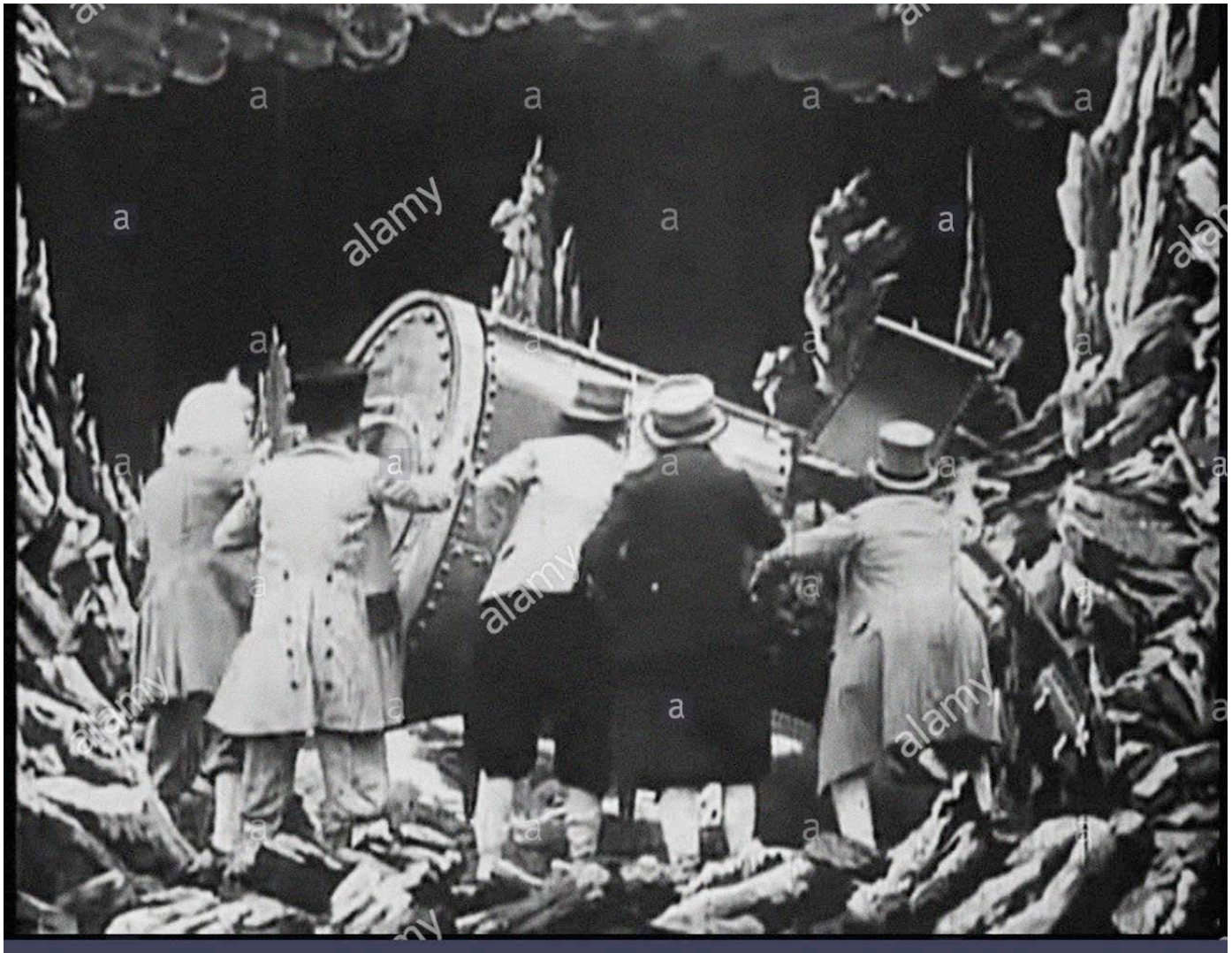


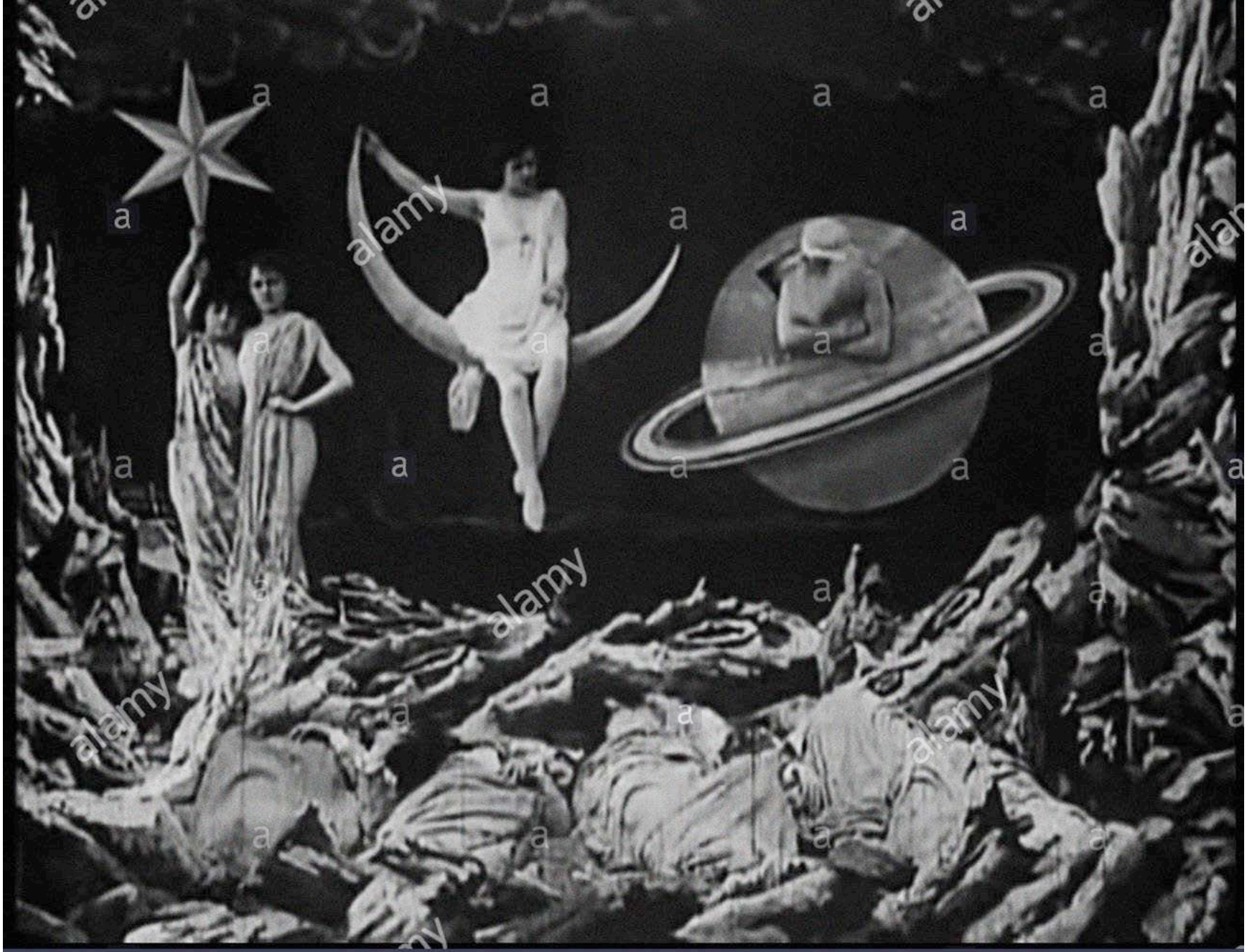
Putovanje na Mesec 1902 Georges Melies

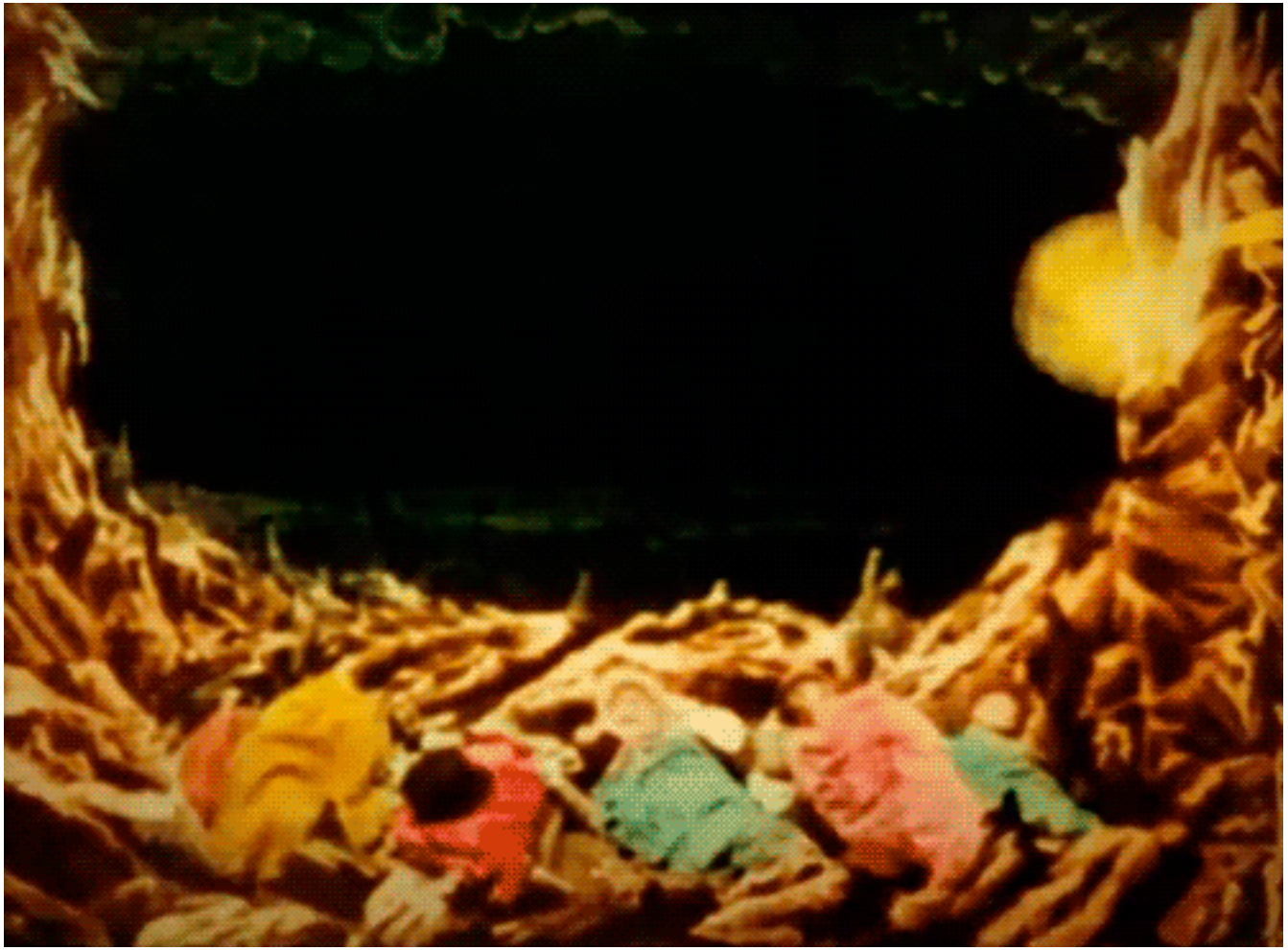


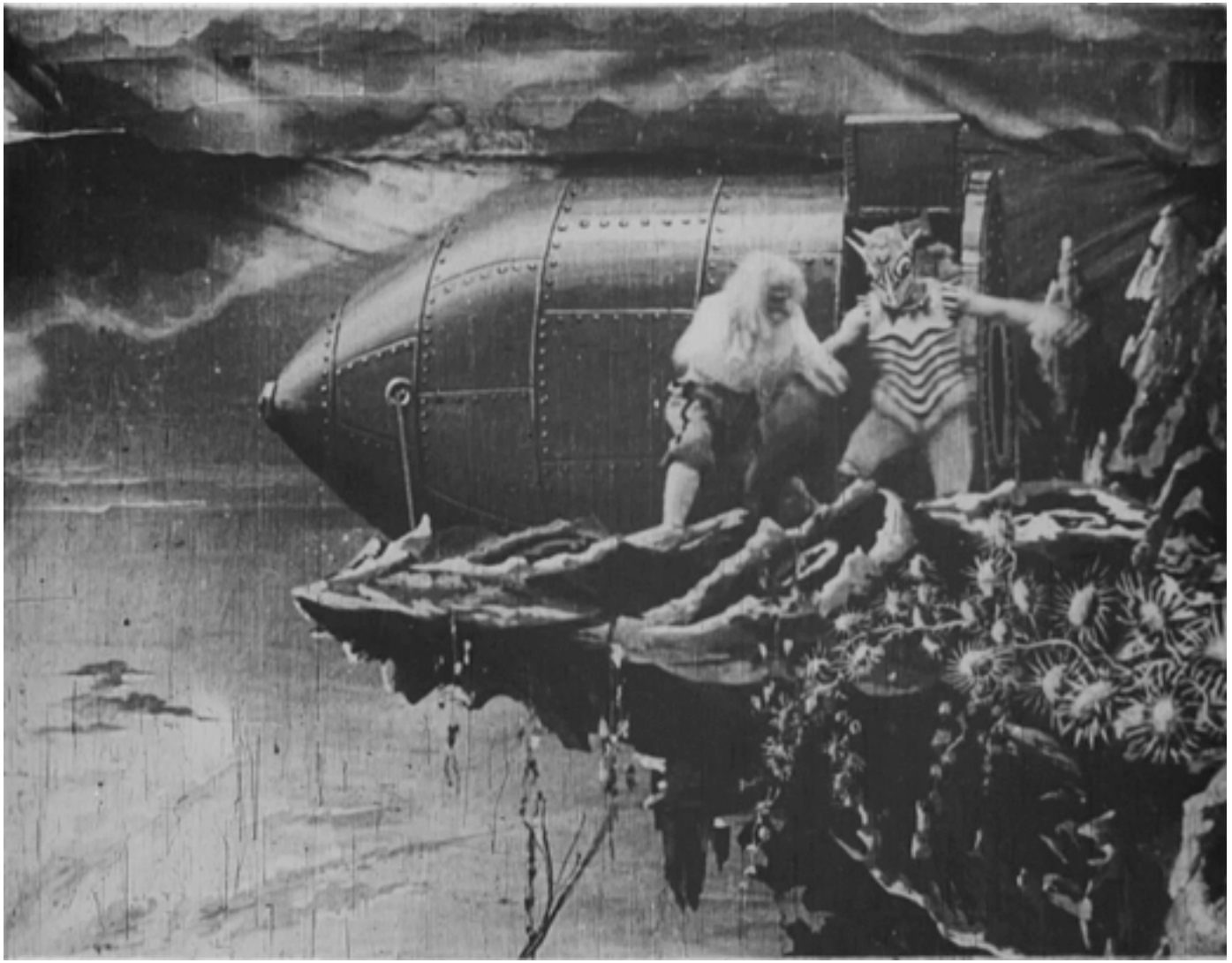
Putovanje na Mesec 1902 Georges Melies

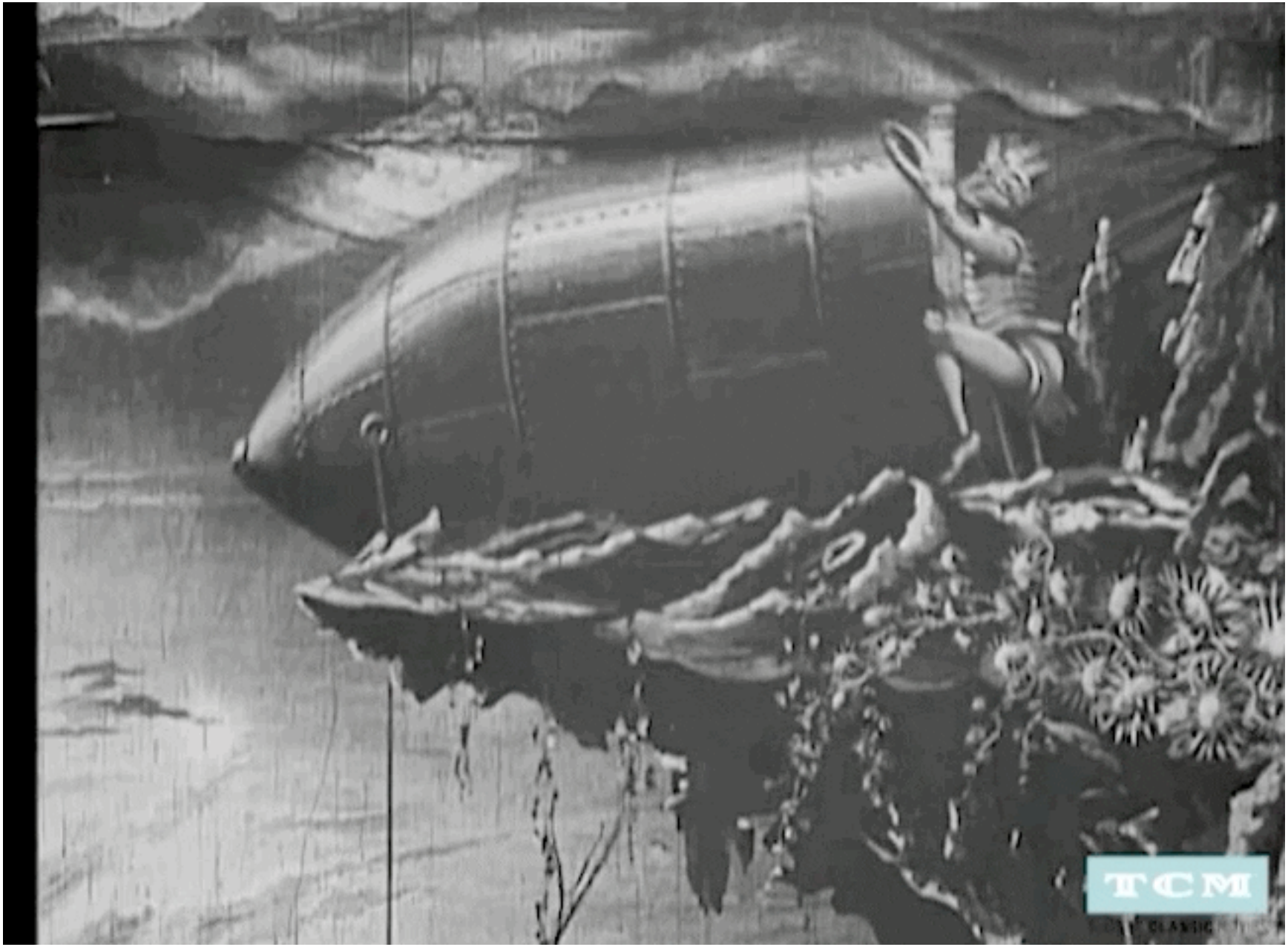
https://www.youtube.com/watch?v=xLVChRVfZ74



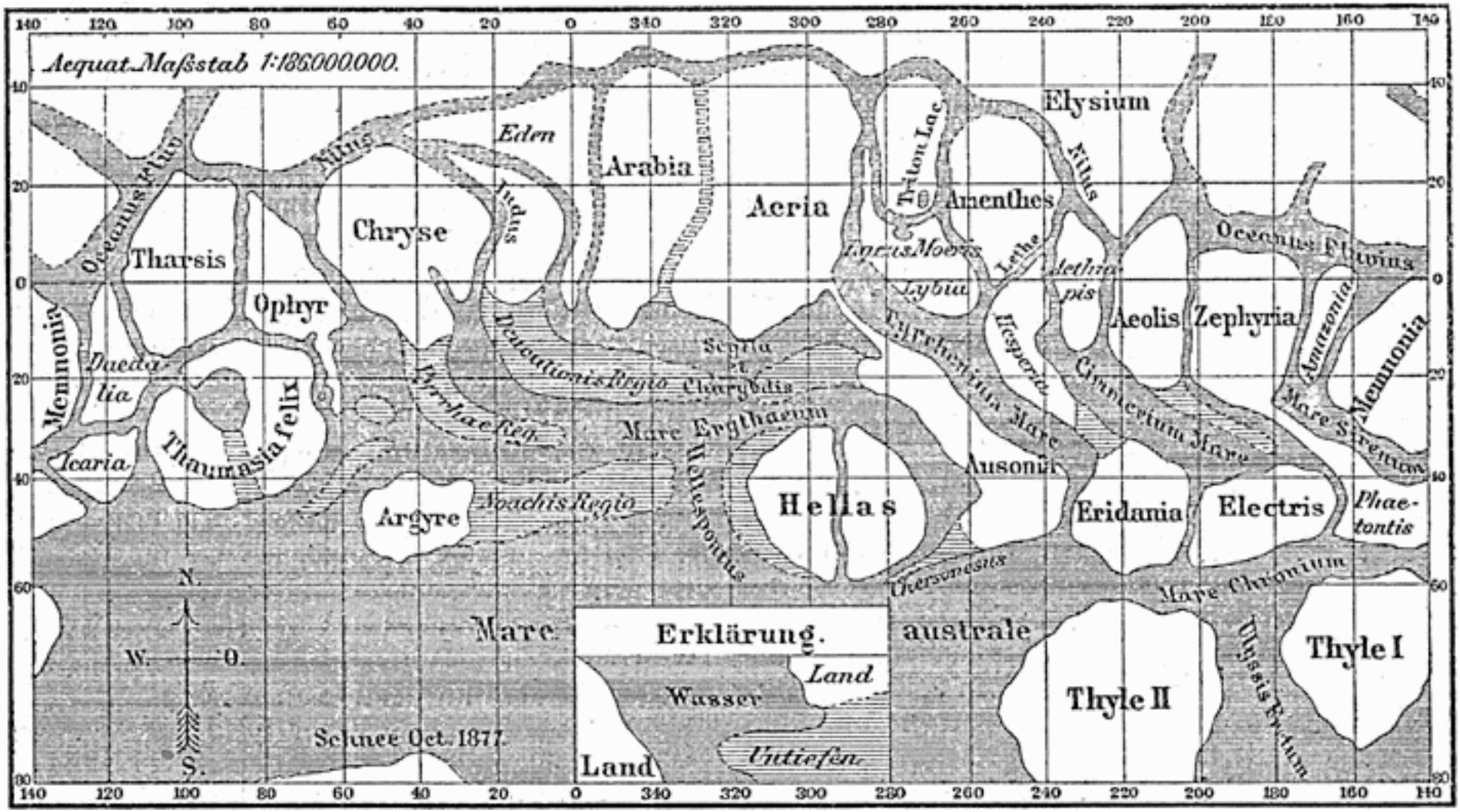




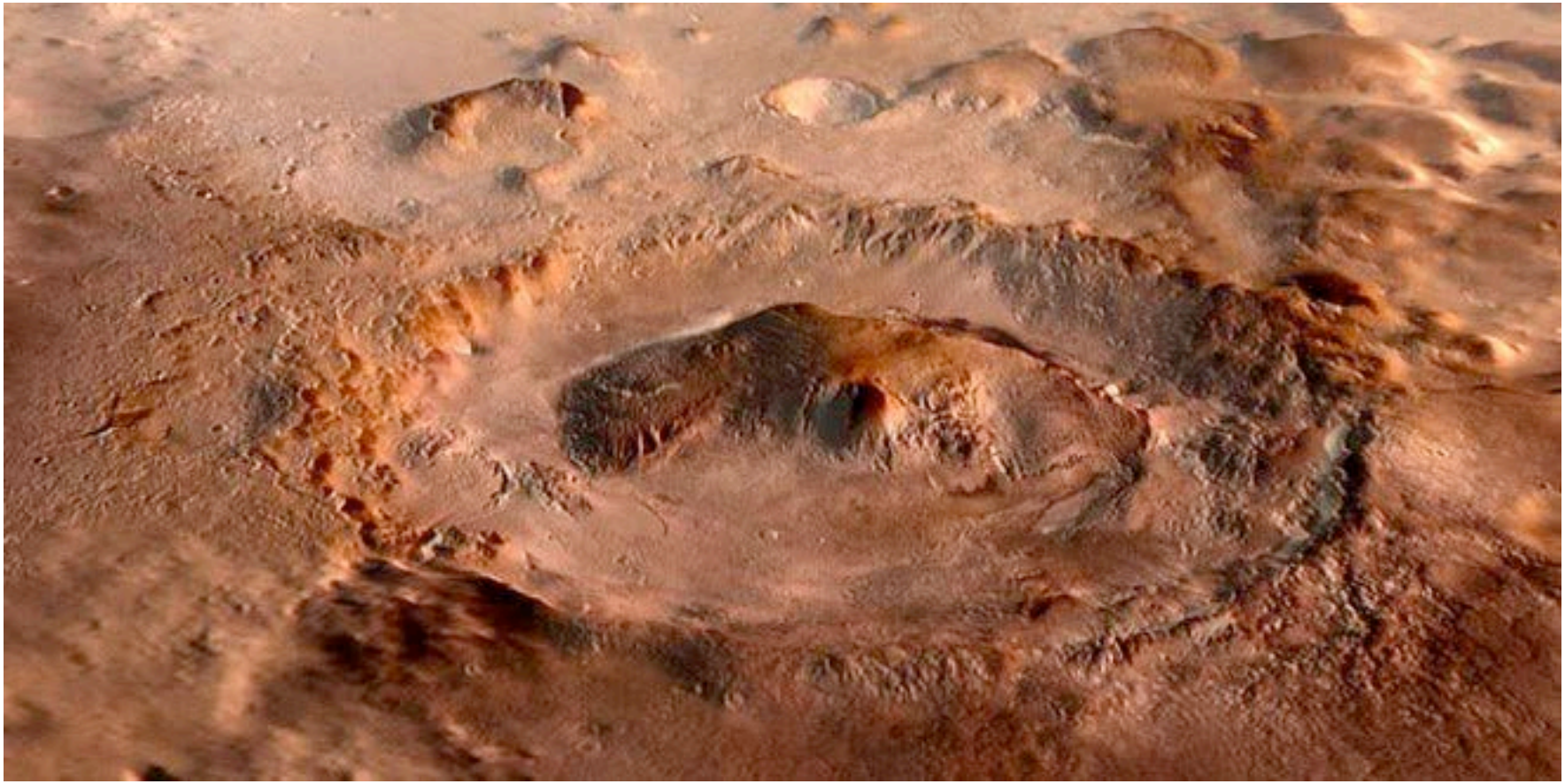


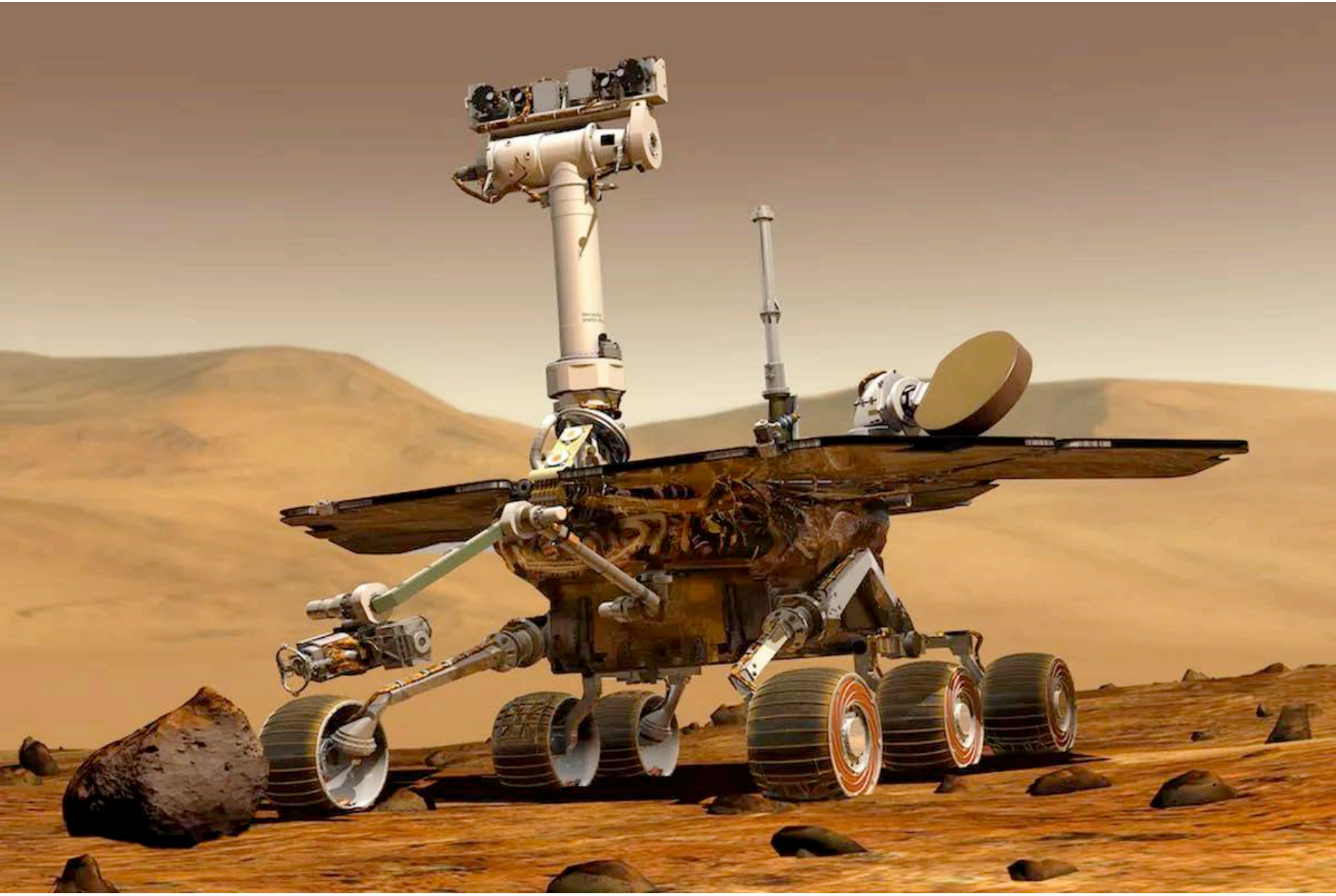

TCM

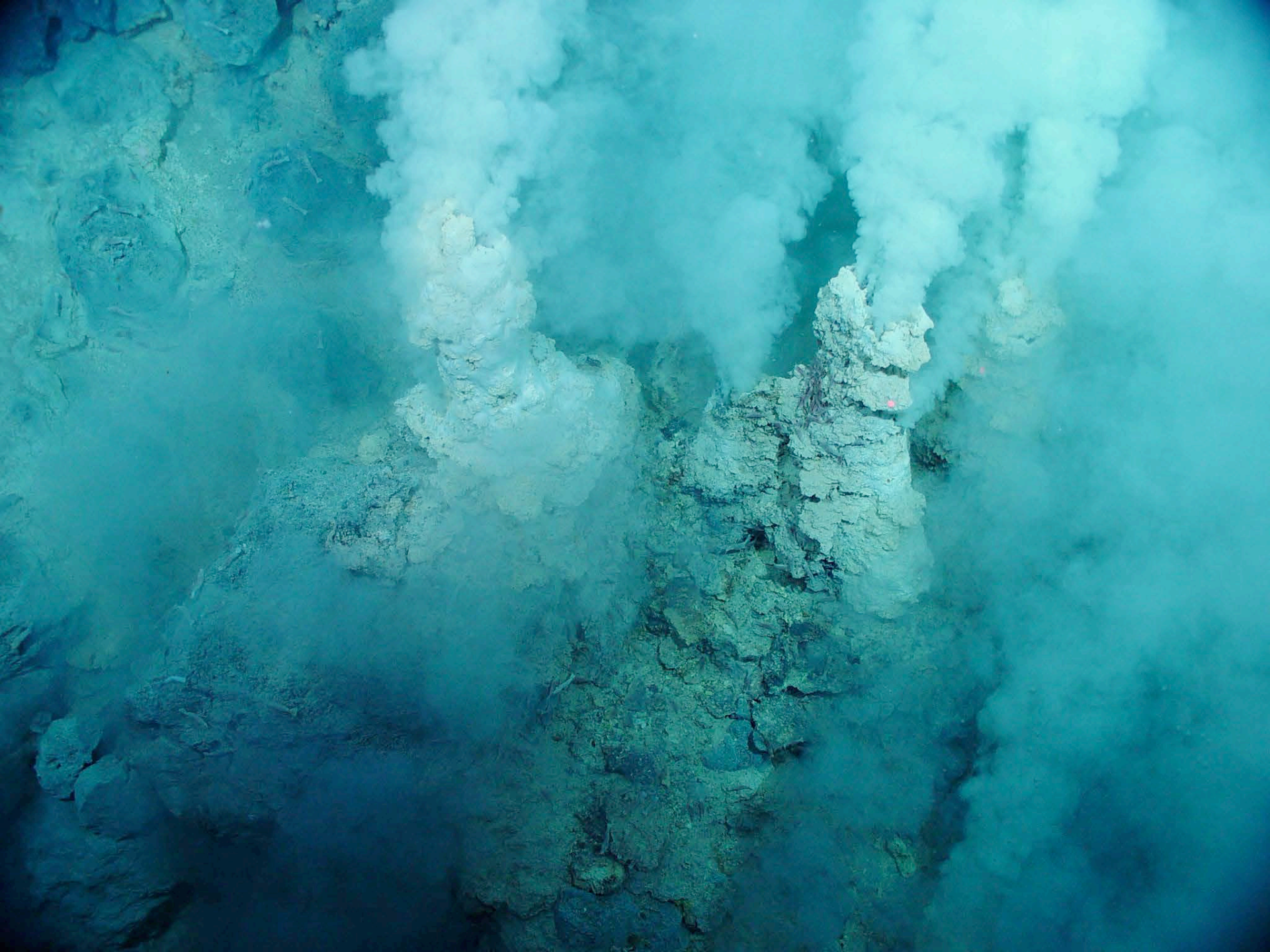
Kanali na Marsu

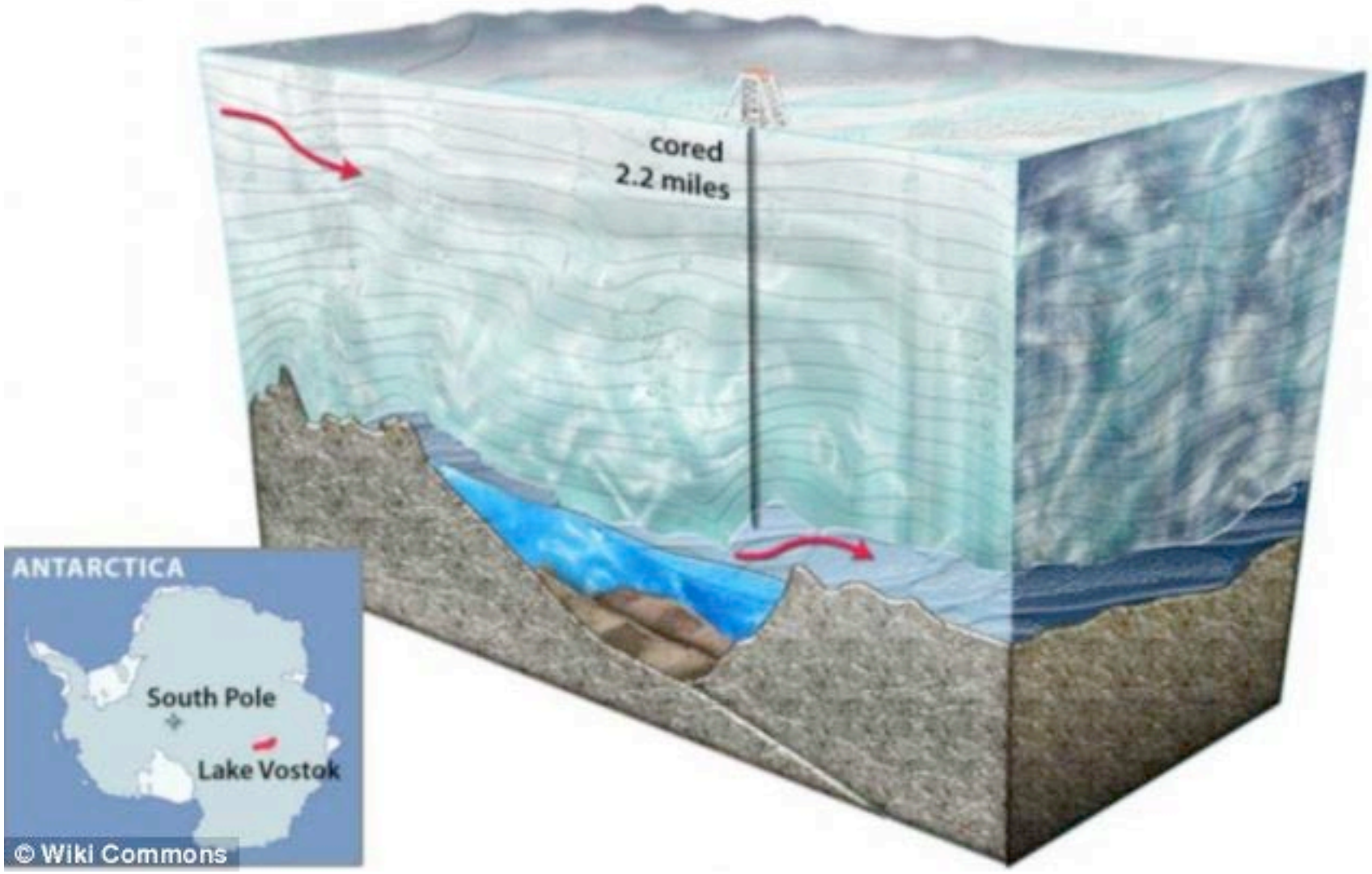


Canali -[Giovanni Schiaparelli](#) during the [opposition](#) of 1877








cored
2.2 miles
ANTARCTICA
South Pole
Lake Vostok
© Wiki Commons

Search for Past Life on Mars: Possible Relic Biogenic Activity in Martian Meteorite ALH84001

David S. McKay, Everett K. Gibson Jr., Kathie L. Thomas-Keprta, Hojatollah Vali, Christopher S. Romanek, Simon J. Clemett, Xavier D. F. Chillier, Claude R. Maechling, Richard N. Zare

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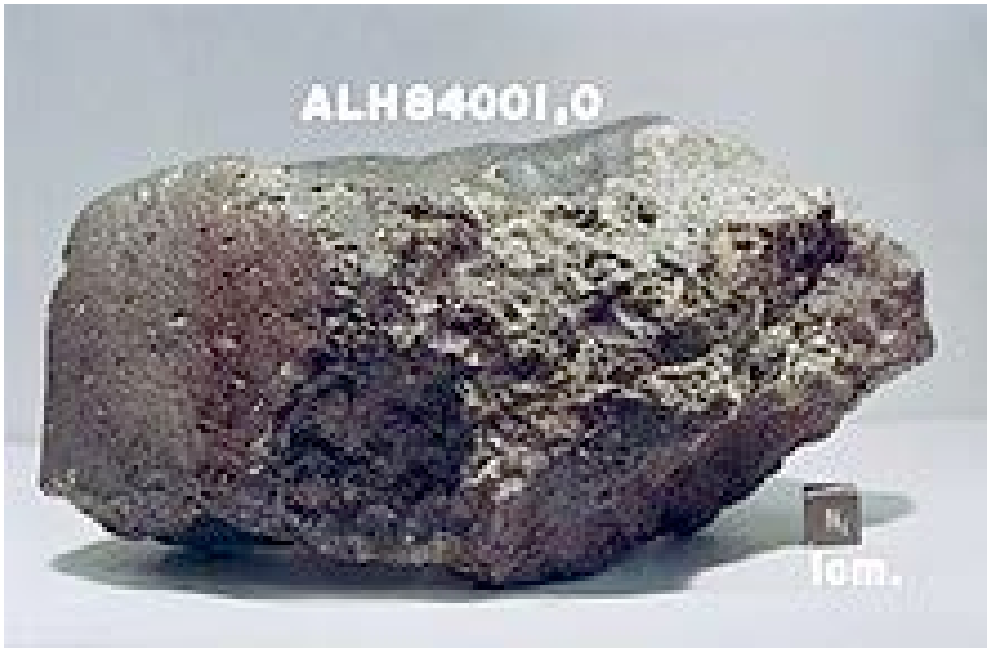
S. J. Clemett, X. D. F. Chillier, C. R. Maechling, R. N. Zare, Department of Chemistry, Stanford University, Stanford, CA 94305-5080, USA.

Science 16 Aug 1996:
Vol. 273, Issue 5277, pp. 924-930
DOI: 10.1126/science.273.5277.924

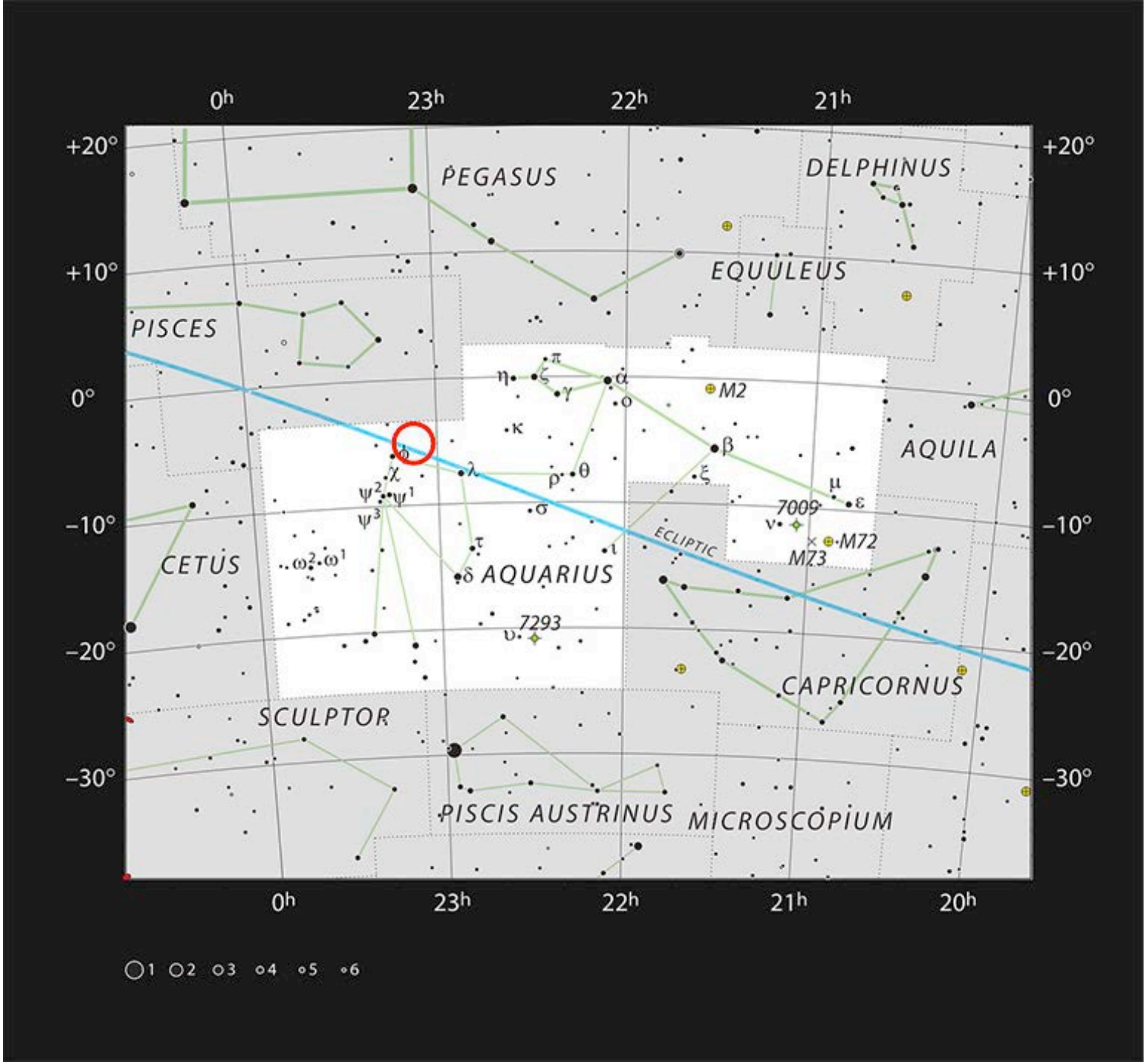


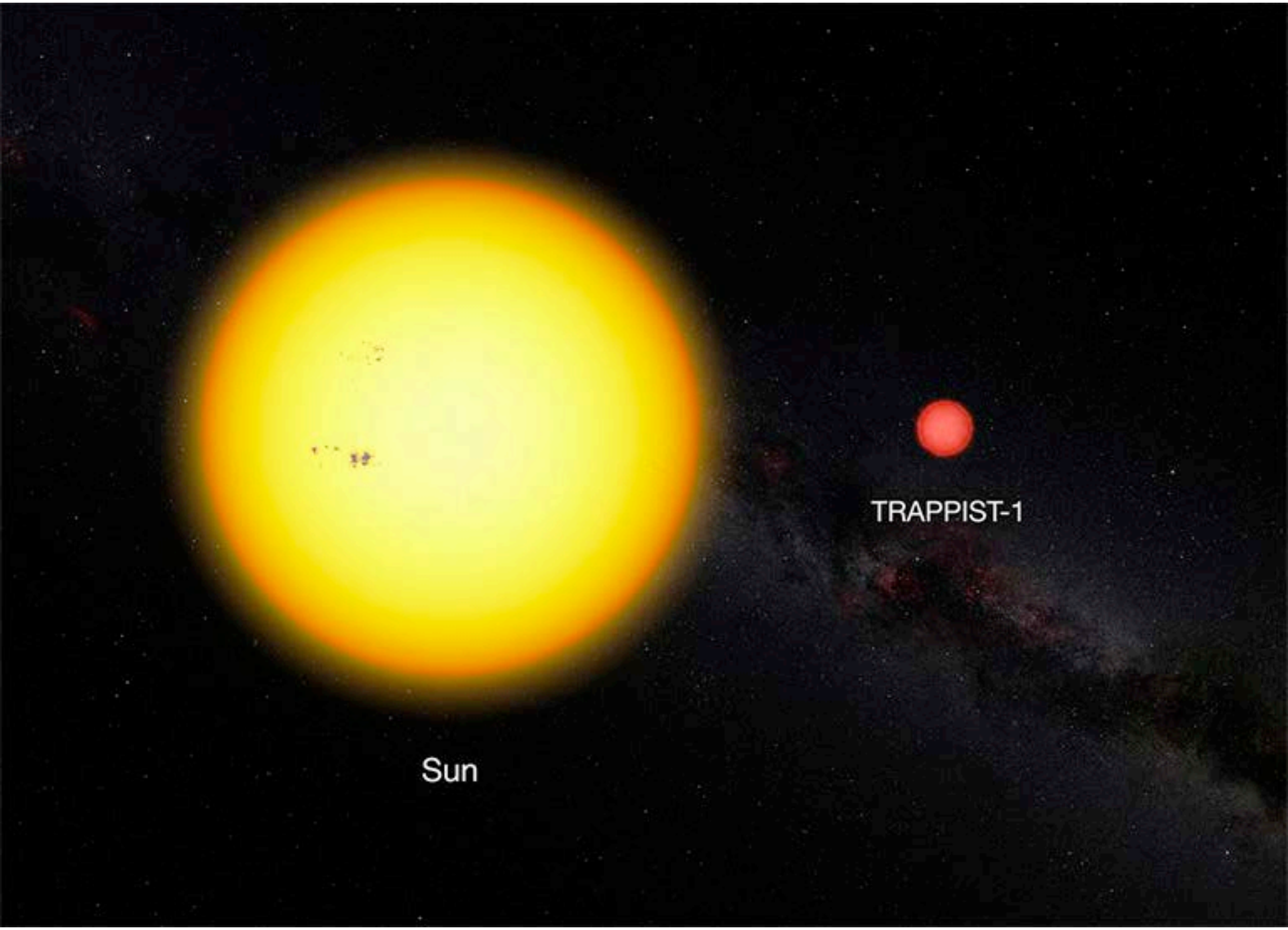
President Clinton Statment Regarding Mars Meteorite Discovery

THE WHITE HOUSE
Office of the Press Secretary
For Immediate Release
August 7, 1996

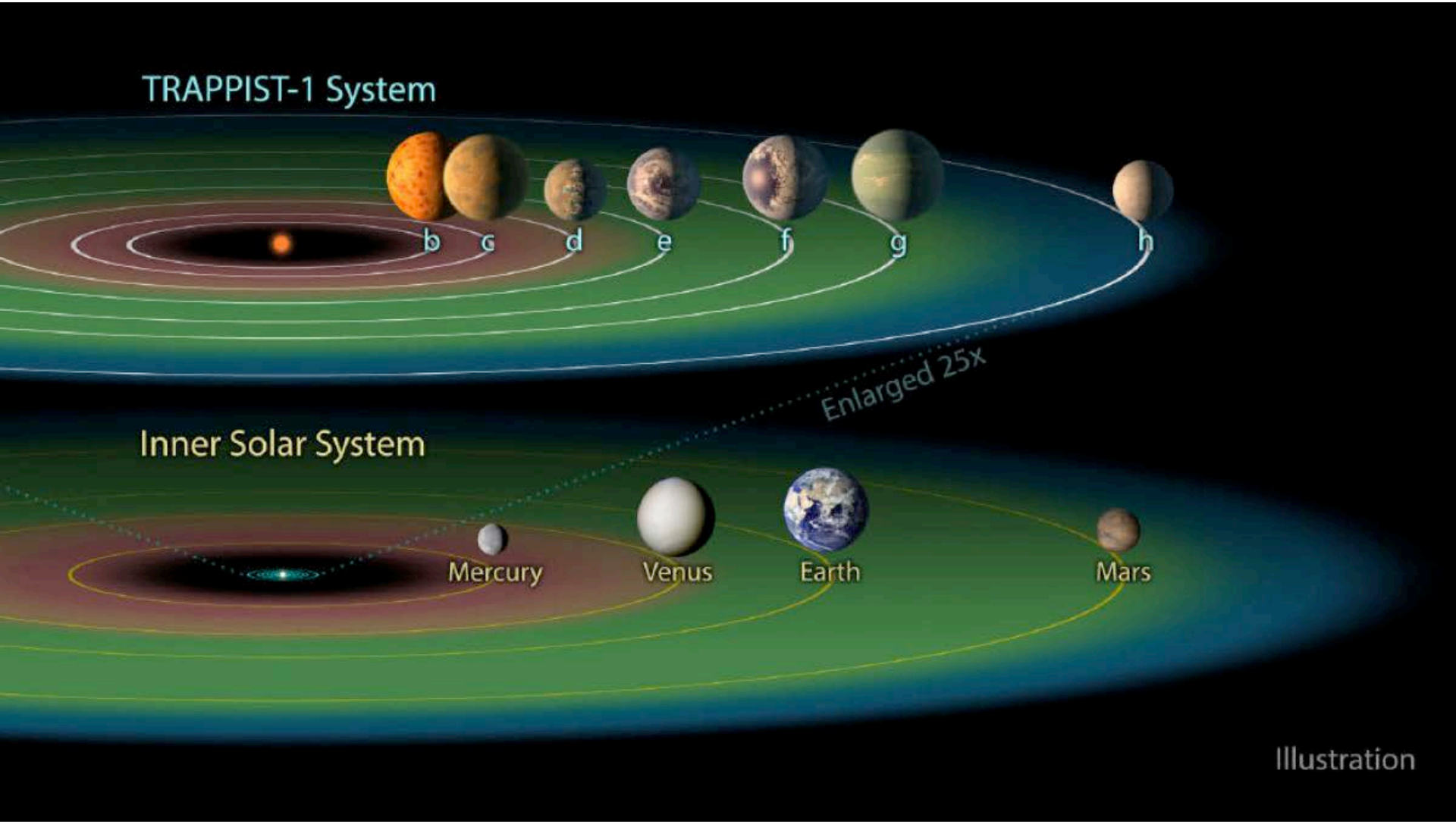
REMARKS BY THE PRESIDENT
UPON DEPARTURE

The South Lawn
1:15 P.M. EDT

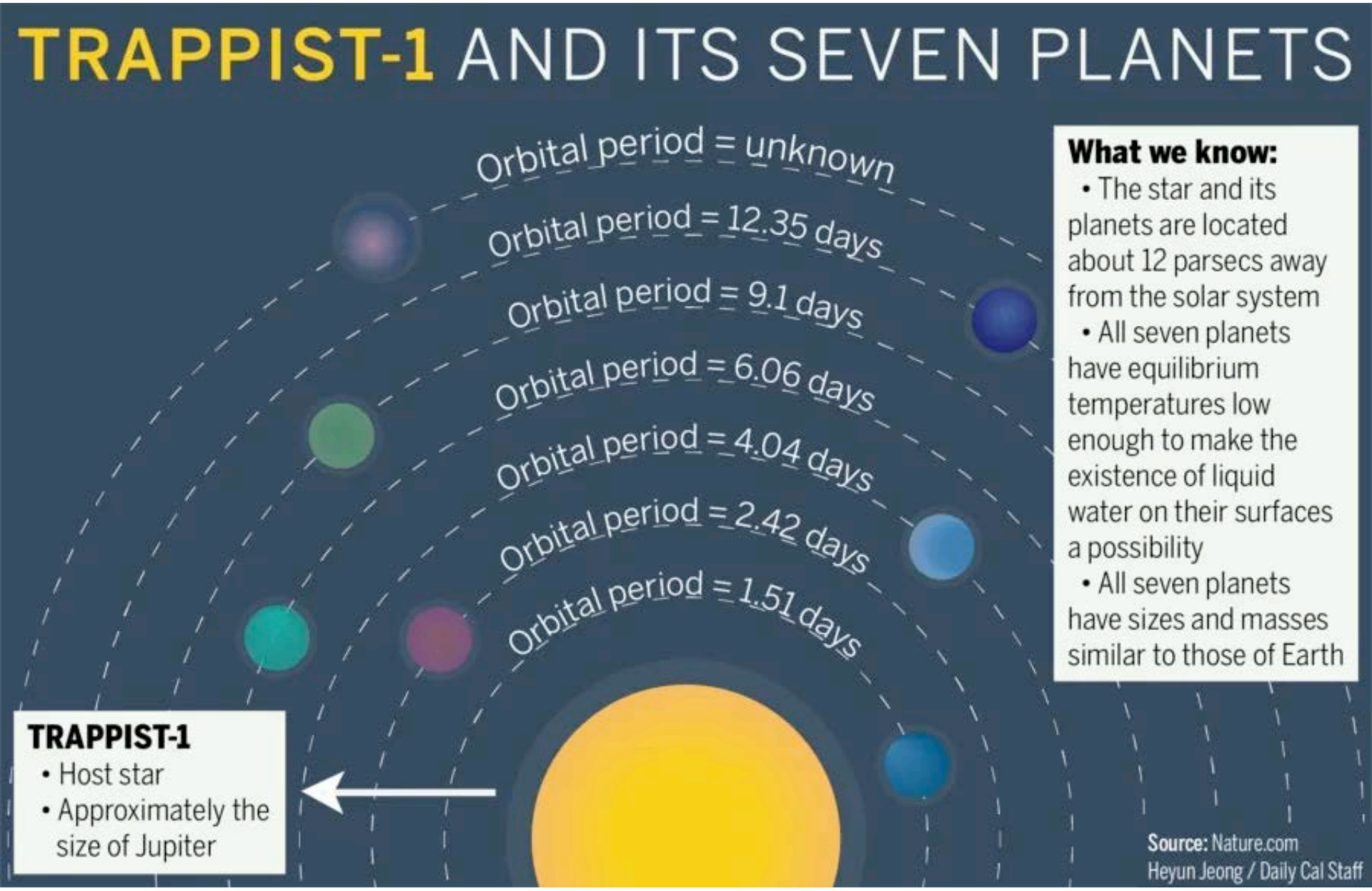

0h
23h
22h
21h
20h
+20°
+10°
0°
−10°
−20°
−30°
PEGASUS
DELPHINUS
EQUULEUS
PISCES
AQUILA
CETUS
AQUARIUS
SCULPTOR
CAPRICORNUS
PISCIS AUSTRINUS
MICROSCOPIUM
ECLIPTIC
M2
M72
M73
7009
7293
1 2 3 4 5 6


TRAPPIST-1
Sun

Januara 2017., NASA je objavila otkriće planetarnog sistema TRAPPIST 1, u sazvežđu Vodolije, na rastojanju od oko 39 svetlosnih godina od nas.



https://www.youtube.com/watch?v=WS5UxLHbUKc&feature=youtu.be


TRAPPIST-1 AND ITS SEVEN PLANETS
Orbital period = unknown
Orbital period = 12.35 days
Orbital period = 9.1 days
Orbital period = 6.06 days
Orbital period = 4.04 days
Orbital period = 2.42 days
Orbital period = 1.51 days
What we know:
• The star and its planets are located about 12 parsecs away from the solar system
• All seven planets have equilibrium temperatures low enough to make the existence of liquid water on their surfaces a possibility
• All seven planets have sizes and masses similar to those of Earth
TRAPPIST-1
• Host star
• Approximately the size of Jupiter
Source: Nature.com
Heyun Jeong / Daily Cal Staff

Muzika sfera

https://www.youtube.com/watch?v=WS5UxLHbUKc&feature=youtu.be

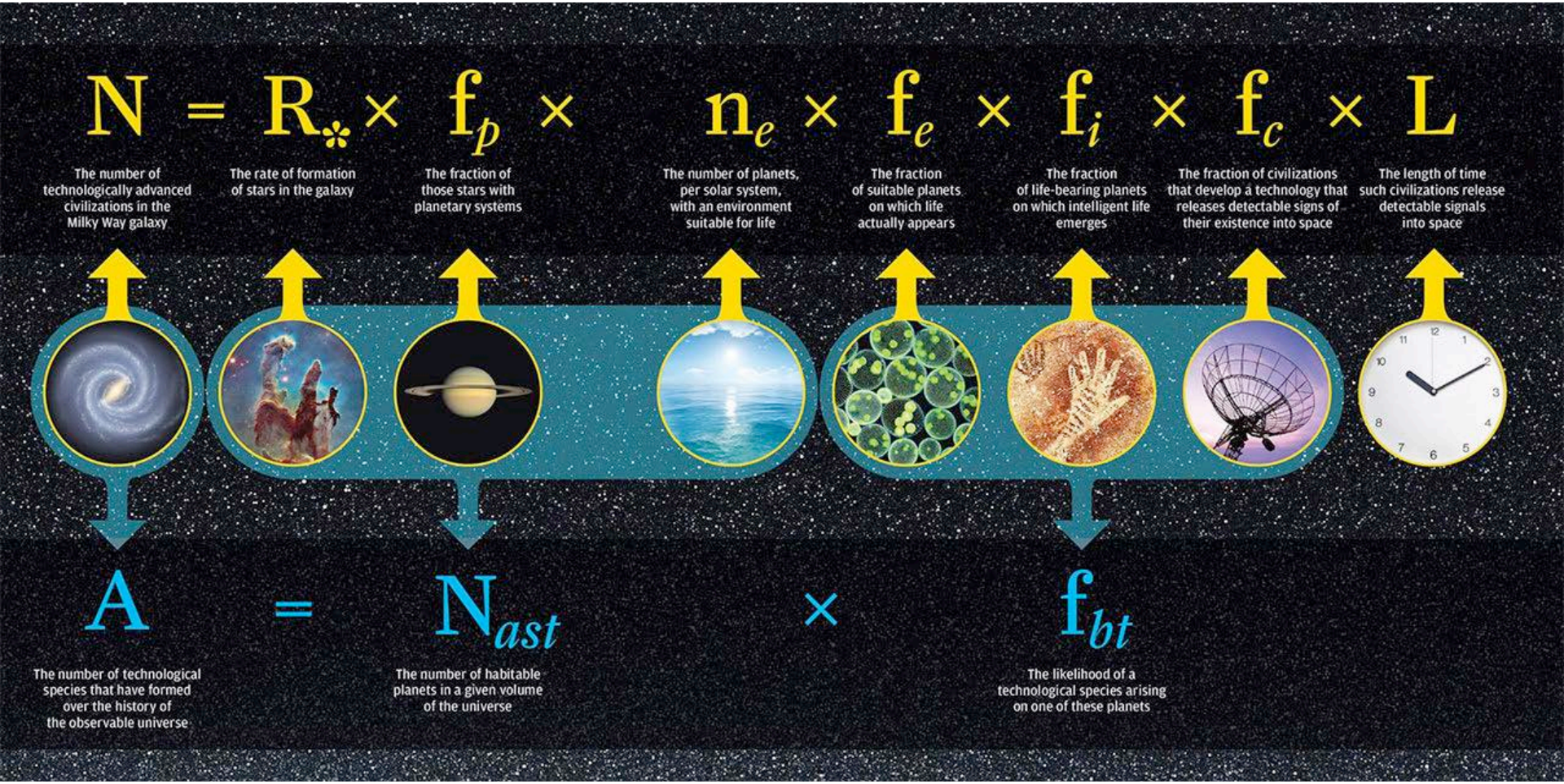
Френк Дрејк 1961

Drake Equation

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

R	average rate of star formation
f_s	fraction of good stars that have planetary systems
n_e	number of planets aound these stars within an "ecoshell"
f_l	fraction of those planets where life develops
f_i	fraction of living species that develop intelligence
f_c	fraction of intelligent species with communications technology
L	lifetime of the "communicative phase"

Дрејкова једначина



Astrobiology, VOL. 16, NO. 5 | Research Articles

normal

A New Empirical Constraint on the Prevalence of Technological Species in the Universe

A. Frank and W.T. SullivanIII

Published Online: 13 May 2016 | https://doi.org/10.1089/ast.2015.1418

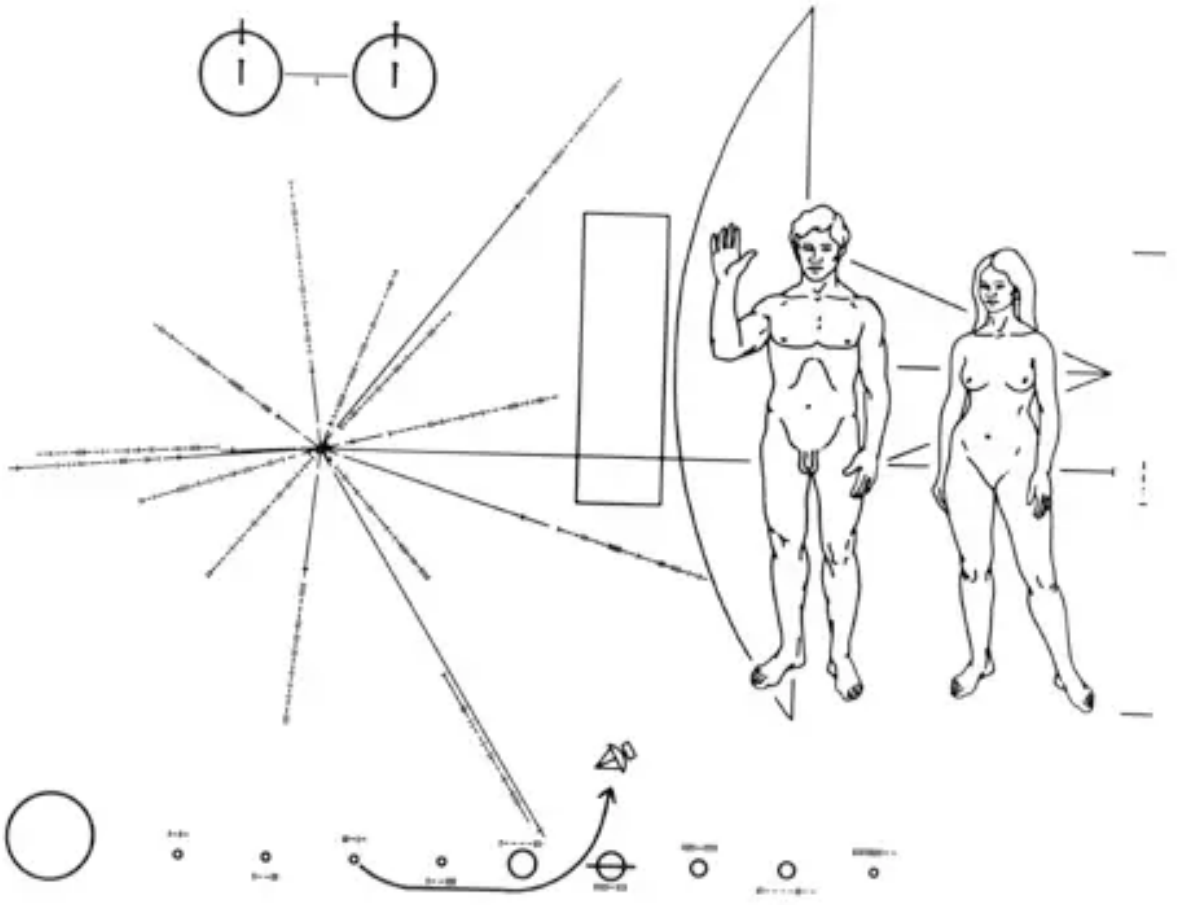
Tools Share

Abstract

In this article, we address the cosmic frequency of technological species. Recent advances in exoplanet studies provide strong constraints on all astrophysical terms in the Drake equation. Using these and modifying the form and intent of the Drake equation, we set a firm lower bound on the probability that one or more technological species have evolved anywhere and at any time in the history of the observable Universe. We find that as long as the probability that a habitable zone planet develops a technological species is larger than ~10^{-24}, humanity is not the only time technological intelligence has evolved. This constraint has important scientific and philosophical consequences. Key Words: Life—Intelligence—Extraterrestrial life. Astrobiology 2016, 359–362.

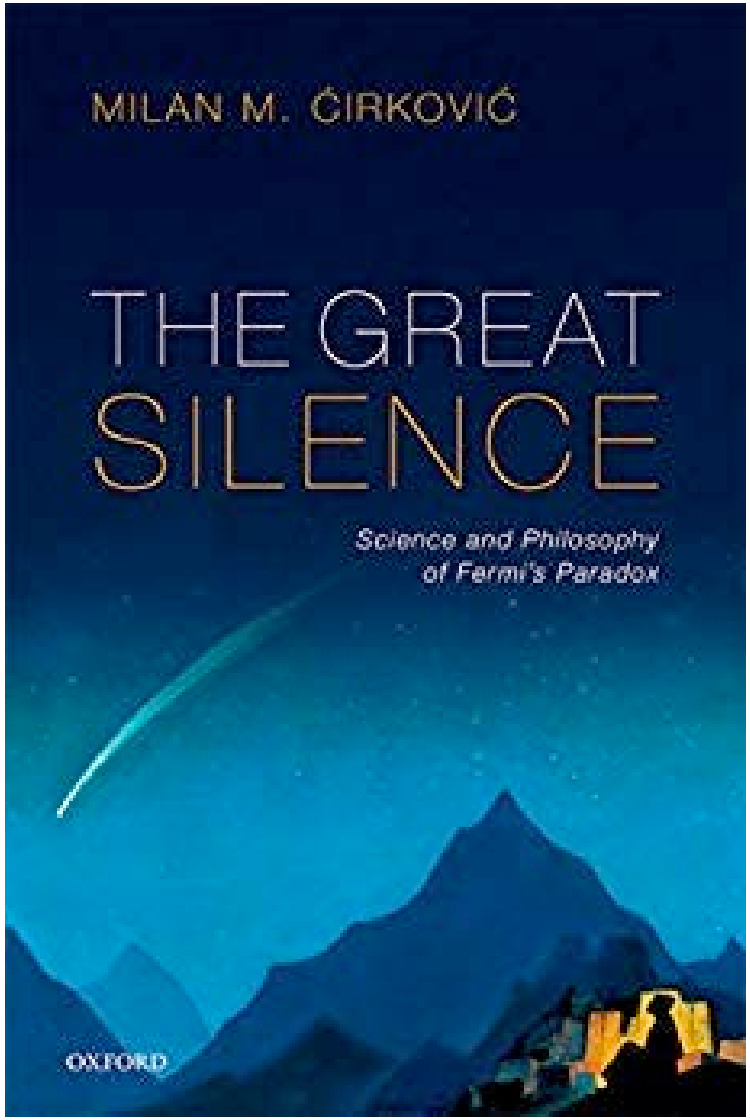
Карл Саган 1934-1996

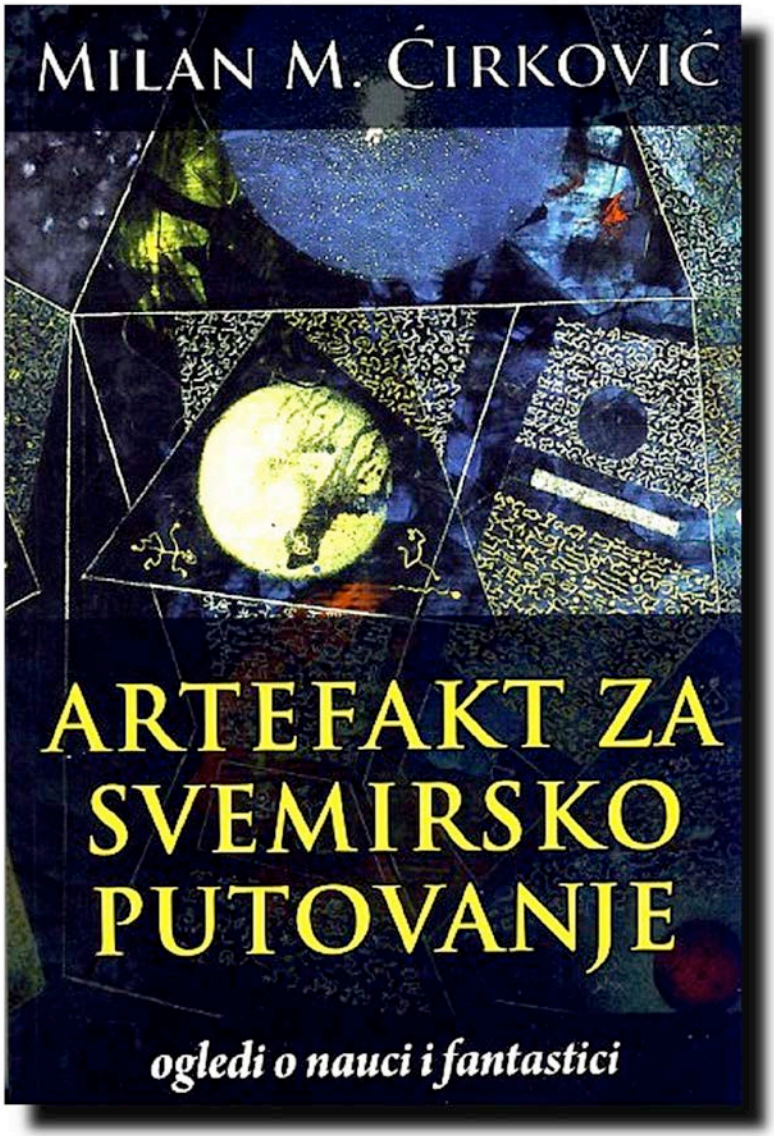
SETI

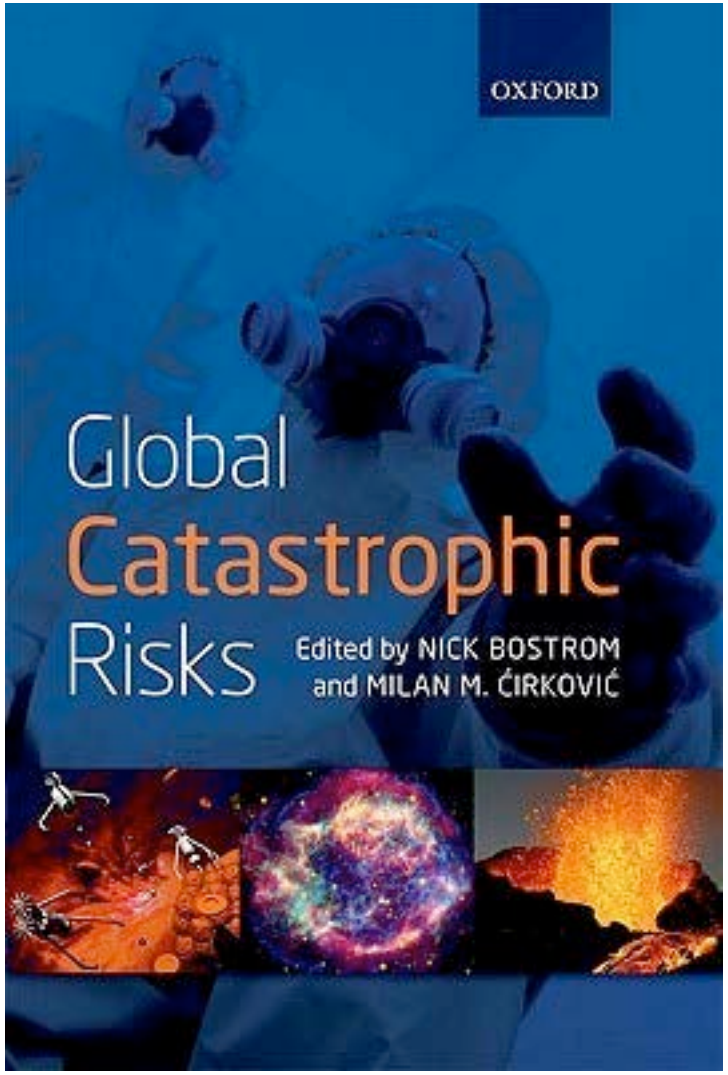


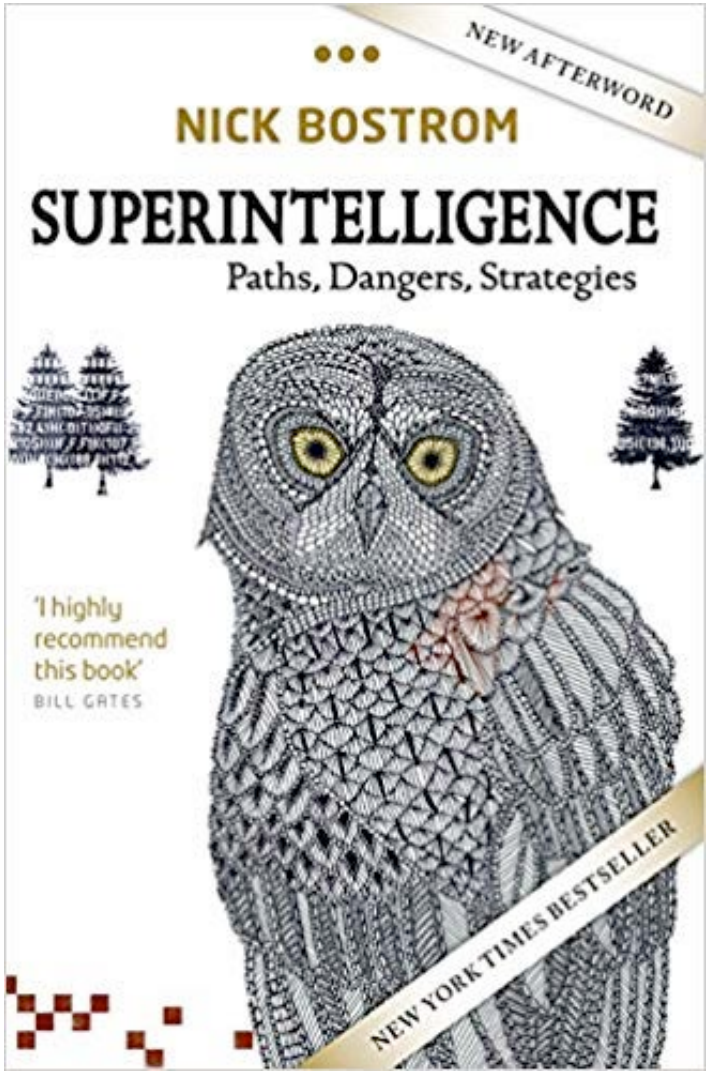
Russian astrophysicist Nikolai Kardashev proposed a useful scheme to classify advanced civilizations, he argues that ET would posses one of three levels of technology. A Type I civilization is similar to our own, one that uses the energy resources of a planet. A Type II civilization would use the energy resources of a star, such as a Dyson sphere. A Type III civilization would employ the energy resources of an entire galaxy. A Type III civilization would be easy to detect, even at vast distances.

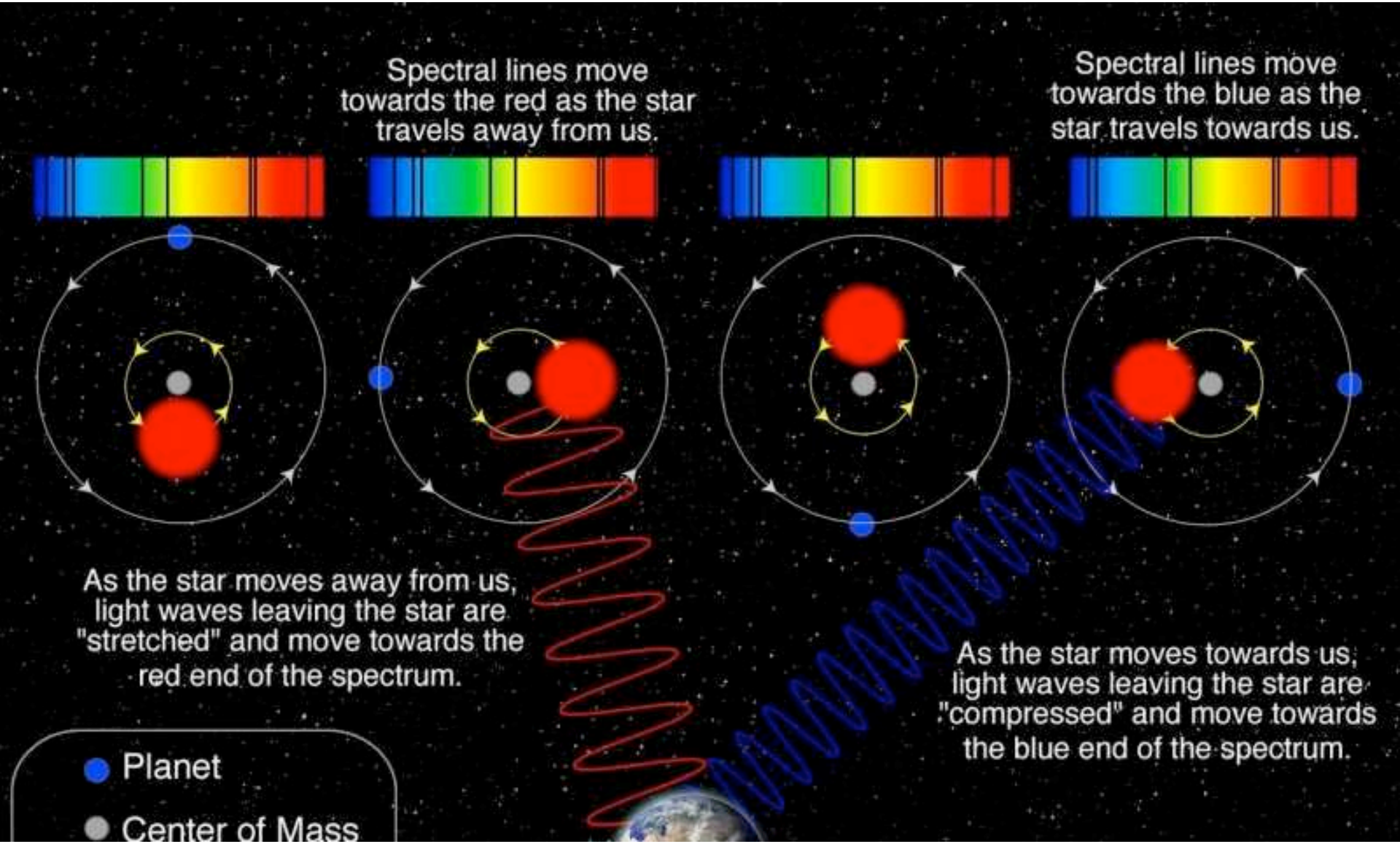
In general, solutions to Fermi's paradox come down to either
1) life is difficult to start and evolve
(either hard for the process or hard to find the right conditions) or
2) advanced civilizations destroy themselves on short timescales.
In other words, this is an important problem to solve in the
hope that it is 1 and not 2.


MILAN M. ĆIRKOVIĆ
THE GREAT SILENCE
Science and Philosophy of Fermi's Paradox
OXFORD


MILAN M. ĆIRKOVIĆ
ARTEFAKT ZA SVEMIRSKO PUTOVANJE
ogledi o nauci i fantastici


OXFORD
Global
Catastrophic
Risks
Edited by NICK BOSTROM
and MILAN M. ĆIRKOVIĆ


NEW AFTERWORD
NICK BOSTROM
SUPERINTELLIGENCE
Paths, Dangers, Strategies
'I highly recommend this book'
BILL GATES
NEW YORK TIMES BESTSELLER


Spectral lines move towards the red as the star travels away from us.
Spectral lines move towards the blue as the star travels towards us.
As the star moves away from us, light waves leaving the star are "stretched" and move towards the red end of the spectrum.
As the star moves towards us, light waves leaving the star are "compressed" and move towards the blue end of the spectrum.
Planet
Center of Mass

Growth of the nonbaryonic dark matter theory

P. J. E. Peebles

Nature Astronomy **1**, Article number: 0057 (2017) | Download Citation

Abstract

The evidence that has accumulated since the 1930s is that the mass of the Universe is dominated by an exotic nonbaryonic form of matter largely draped around the galaxies. This dark matter approximates an initially low-pressure gas of particles that interact only with gravity, but we know little more than that. Searches for detection thus must follow many difficult paths to a great discovery: what the Universe is made of.

Article | Published: 23 November 1995

A Jupiter-mass companion to a solar-type star

Michel Mayor & Didier Queloz

Nature **378**, 355–359 (1995) | Download Citation

14k Accesses | **2312** Citations | **679** Altmetric | Metrics »

Abstract

The presence of a Jupiter-mass companion to the star 51 Pegasi is inferred from observations of periodic variations in the star's radial velocity. The companion lies only about eight million kilometres from the star, which would be well inside the orbit of Mercury in our Solar System. This object might be a gas-giant planet that has migrated to this location through orbital evolution, or from the radiative stripping of a brown dwarf.


Хвала!