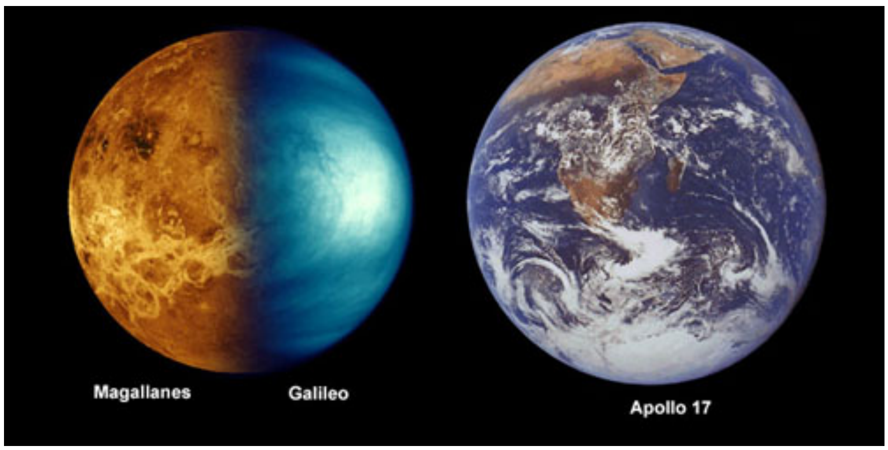
What Happened to Venus

By Clark M. Thomas



Venus is the third brightest object in our skies. Only our moon and the sun itself are brighter. Inexperienced star gazers may mistake Venus for Polaris, the north star. Ancient humans marveled at the brilliant blue-white "evening star" which shines just like the "morning star." They are the same wandering "star."

Venus' cloud cover reflects much of the visible light from the sun, which is to say it has a high albedo. It orbits inside Earth's orbit, inside today's Goldilocks zone. Four billion years ago the sun was 20% less bright, and for nearly all of its earlier existence Venus orbited just within the so-called Goldilocks zone. Scientists have long suspected that ancient Venus, which is a near volume twin of Earth, could have supported seas and life.

Today's Venus has a nasty sulfur and carbon gases atmosphere ninety times as thick as Earth's. Venus has a surface hot enough to melt lead, with some volcanoes possibly still active. Venus today is a killer, hardly the proverbial Goddess of Love.

Astronomers look at Venus with awe and horror. Our industrial Anthropocene period is now generating rising seas and hot skies. Is something like the fate of Venus in store for Earth in the near future? Hopefully not. Science does know that blue-planet Earth's future climate may become within a few centuries much too hot for advanced protoplasm such as ours.

The real puzzle is discovering what happened (and when) to make Venus into Hell: (V = H). This puzzle has only now become an elementary problem, thanks to recent scientific data. We simply eliminate several unlikely scenarios to reveal the most likely probability. That best-guess solution is revealed below.

Some Basic Data

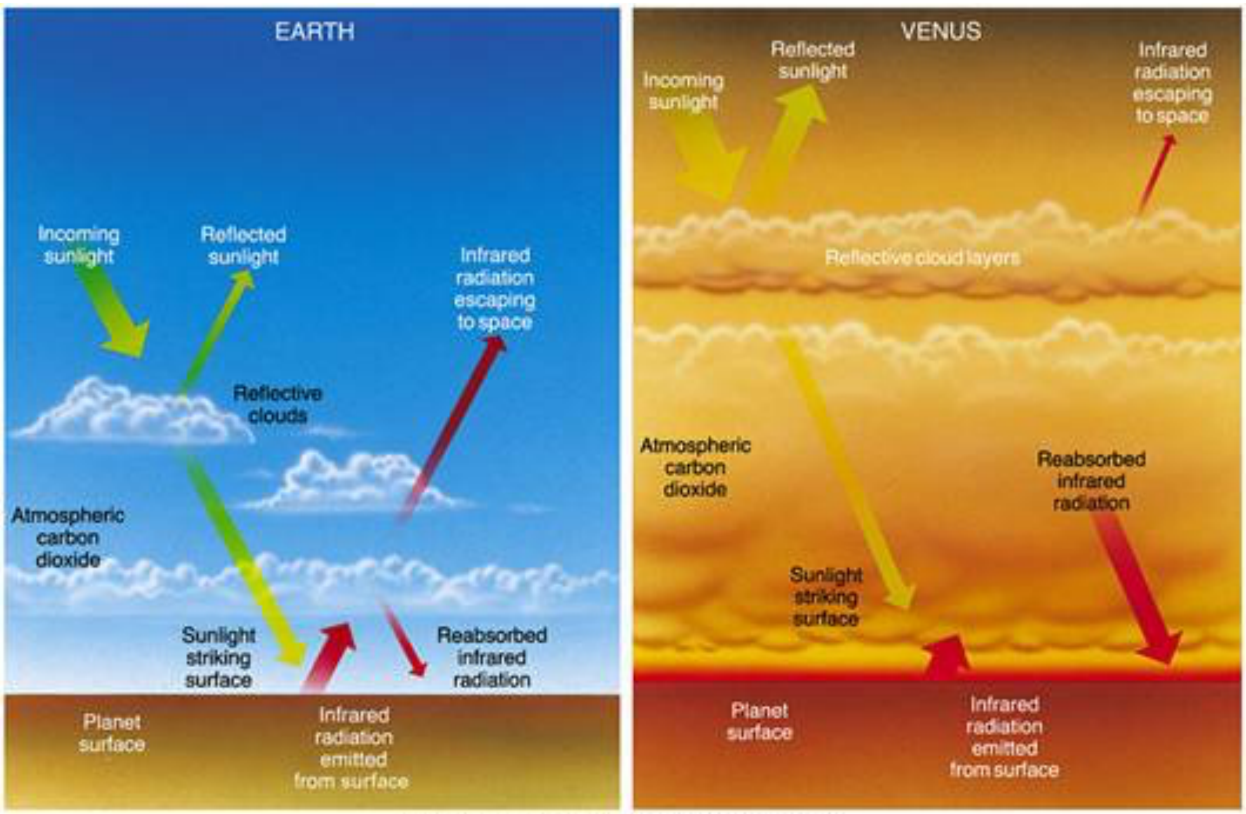
It is well known that Venus has the worst sort of greenhouse atmosphere. Earth's benign atmosphere is composed of nitrogen, oxygen, hydrogen, argon, helium, and a small amount carbon dioxide and other greenhouse gases. Plus water vapor. Our atmospheric CO2 is rising too fast for normal biosphere recycling, because human industrial activities and exploding population are producing CO2 faster than the land and water can hide it away. Nevertheless, greenhouse gases are still low enough to tame with GREAT effort WITHOUT DELAY over the next two *centuries*.

Until about 700 to 750 *million Earth years* ago Venus was likely a water planet with shallow seas possibly hosting many life forms, some of which could have first arrived on meteorites from Mars or Earth. Independently, around that time *SOMETHING HAPPENED* to push Venus onto the path of becoming a hellish dead planet.

> "The atmosphere of Venus is 90 times more dense than that on Earth and it is made of 96.5% of CO2 and a 3% of nitrogen. This means that both planets have the same amount of Nitrogen on their atmospheres. Surprisingly the CO2 on Earth is stored on calcite type rocks and if we would convert the CO2 on these rocks into atmospheric CO2 it

would amount to the same amount of CO_2 that there is on Venus' atmosphere."[1]

Above the dense CO_2 atmosphere is a thick layer of reflecting sulphur gases generated by volcanos. It exists from 40 to 50 kilometers above, and is partially responsible for the hottest environment of any rocky body in this solar system, approaching almost 800º Fahrenheit. On today's Venus unprotected human flesh would not get a sunburn; it would burst into flames.



There is no scenario within the next one hundred million years where Earth's atmosphere would remotely approach that of Venus, even though both planets have roughly the same amount of total CO_2. Most of Earth's CO_2 is locked in rocks, and is involved in global plate tectonics. Venus has local, not global, plate tectonics. Nevertheless, all life on Earth would perish at much higher temperatures, especially after oxygen escapes and

[1] http://www.ajax.ehu.es/VEX/Venus.Earth/Venus.Earth.html

all water evaporates. Ironically, CO_2 in the atmosphere helps sustain plant life, but not too much of it.

A recent computer modeling study looked at a suite of life scenarios for the *pre-disaster* Venus. *All models revealed a previously life-friendly result, with plenty of water*:

> "We have created a suite of 3-dimensional climate simulations using topographic data from the Magellan mission, solar spectral irradiance estimates for 2.9 and 0.715 billion years ago, present-day Venus orbital parameters, an ocean volume consistent with current theory and measurements, and an atmospheric composition estimated for early Venus. Using these parameters we find that such a world could have had moderate temperatures if Venus had a rotation period slower than about 16 Earth days, despite an incident solar flux 46–70% higher than modern Earth receives. At its current rotation period of 243 days, Venus's climate could have remained habitable until at least 715 million years ago if it hosted a shallow primordial ocean. These results demonstrate the vital role that rotation and topography play in understanding the climatic history of exoplanetary Venus-like worlds being discovered in the present epoch."[2]

What Went Wrong

There are a few scenarios that could have produced Venus = Hell:

(1) Plate tectonic volcanism: Earth vs. Venus,
(2) Soaring solar heat,
(3) Venus and Earth having very different origins,
(4) Large impactors: Venus vs. our moon.

2 https://arxiv.org/pdf/1608.00706.pdf

(1) Plate Tectonic Volcanism: Earth vs. Venus

(1a) Earth Tectonics

Earth’s planetary tectonics did not begin when the Earth was formed 4.6 billion years ago. Before about 3.5 to 3.2 billion years ago the hot mantle brought up molten material directly to the surface. These plumes formed the first fractions of continental crust. A small portion of pre-tectonic crust up to four billion years old is in Greenland.

Even earlier the entire Earth was molten twice, at first when formed, and not too long thereafter when a Mars-sized impactor blasted the newly solid Earth, ejecting magma, some of which became our moon. Whereas most land surfaces are the product of global plate tectonics, there are still a few areas such as the Hawaiian Islands that have formed from deep mantle plumes.

Around 3.5 to 3.2 billion years ago the Earth's interior began to run low on heat-generating radioactive elements. The mantle cooled down somewhat, and there were fewer magma plumes. Stable convection cells formed in the mantle, and started driving plate movements and subduction, and thus global plate tectonics began to shape the Earth’s crustal surface.[3]

We are tempted to imagine Earth’s magma history as similar to what happened to Venus. There are at least two major periods on Earth where major (but not total) extinctions have been associated with prolonged tectonic magma eruptions within the Siberian Traps,[4] and later within the Deccan Traps[5] in what is today’s northwestern India.

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3 https://www.livescience.com/31570-plate-tectonics-began.html

4 https://www.le.ac.uk/gl/ads/SiberianTraps/Introduction.html

5 http://astronomy-links.net/dinosaurs.pdf

The key difference between Earth and Venus is how their plate tectonics work. Earth's engine is global, but Venusian plate tectonics is not. Water is needed to lubricate the subduction of global plate systems, and that is no longer on Venus. We would be tempted to imagine that Earth's volcanic eruptions should have been greater, but the opposite is true. Today there are just a few active volcanoes on Earth, and possibly on Venus, none of which could alone generate a Venus-level catastrophe.

Venus has over a thousand volcanos over its surface, capable of collectively producing far more magma than oozed out in Siberia and India. We do not precisely know how many million years ago these volcanoes erupted, but their net effect was to resurface much of Venus, leaving only a few relatively elevated "continental" areas with zero life forms, and no seas. We have some data correlation, but not pecise Venusian causation.

Tectonics cannot fully explain anything near what happened to Venus. In fact, the recycling aspect of Earth's global tectonics has helped keep most of Earth's carbon locked in our rocks. In contrast, the great catastrophe in Venus released vast quantities of CO2 and sulfur dioxide within a few million years.

(1b) Venus Tectonics

Although we have just discussed Venus' tectonics, there is another theory worth considering:

> "It is likely, based on what we see now, that what happened on Venus 500 million years ago was due to a turning over of the surface. Without the water to allow for plate tectonics, it is harder for Venus to get rid of its internal heat. So, the mantle gets hotter and eventual melts the crust, forming a whole new surface. This process probably takes about 100 million years and is probably when most of the volcanoes on Venus formed—very little erosion to weather them away."[6]

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[6] https://www.psi.edu/epo/faq/venus.html

This Venus theory is almost persuasive. However, it does not explain the problem of when water first accumulated on Venus. If Venus had shallow seas for literally billions of years, then there would have been ample time for developing Venusian plate tectonics to help release and lower mantle energy. If so, then we are without a strong explanation for the totally hellish surface transformation that followed.

Since Venus was born about the time as Earth, why did it take almost four billion years for the early Venusian mantle to heat up enough to melt the crust? Wouldn't the radioactive core of Venus have cooled sufficiently to generate global tectonics, since Venus supposedly had plenty of water?

Even if Venus' water vanished, say, a billion years ago, that still leaves three billion years for the radiation to have diminished. Earth's mantle cooled enough for global tectonics to start in just over one billion years. Instead, there is a great eruption of Venusian volcanism around seven or eight million years ago, which alone would have been sufficient to essentially recreate the crustal surface we see today.

(2) Soaring Solar Heat

Our everyday sun is gradually increasing its total heat output. Such transformation is typical among ordinary G2 main sequence stars. We are talking here about "solar time," not human time. In human time our squishy protoplasm experiences such things as sunspot cycles and occasional coronal mass ejections. Both short-term event categories are irrelevant to long-term Earth climate.

In the distant past, Venus, though closer to the sun than Earth, had the advantage of a sun with about 20% less energy. This allowed for possible shallow seas, with areas of land, and warm temperatures favorable to complex life. Billions of years ago Venus was just in the solar Goldilocks zone.

Today's Venusian hellish atmosphere is not the product of our sun's gradual increase in temperature, while Venus has been pushed toward the hot side of the Goldilocks zone. In contrast, both Earth and Mars are currently in the Goldilocks zone.

A billion Earth years from now the sun's diameter will likely expand toward the charred Earth, possibly reaching the Earth's orbit itself. A nova will ensue. That's a very, very long time in our future, and thus irrelevant to this Anthropocene period of brilliant stupidity.

(3) Do Venus and Earth Have Very Different Origins?

If Venus and Earth came to be from different star-forming clouds, or from entirely different birth scenarios from Day One, then finding the best explanation for Venus = Hell would be more difficult, even with today's data.

Fortunately, today's astronomical data, including specialized satellites and radar, give us critical tools for eliminating fanciful planetary scenarios from within and beyond the infant solar system.

Earth is however significantly different from Venus in that it has a large nearby moon, and Venus has no moons. Even Mars has two tiny moons, probably captured asteroids. Earth's moon most likely came from a direct collision with a Mars-sized early planetoid, which has several critical lessons for our V = H puzzle. Retrieved Apollo rocks prove how crustal moon rocks are very similar to Earth rocks, indicating a common origin.

(4) Large Impactors: Venus vs. our Moon

(4a) The great lunar impactor

For hundreds of years it was assumed that the far side of the moon would be similar to the near side visible from Earth. In the late last century both rockets and orbiting humans saw a very different looking Moon. Both lunar halves have many craters of variable sizes. However, only one side has multiple giant *maria*, or seas. The imaginary “Man in the Moon” was inspired by the idea that the giant dark “seas” are shallow seas full of water.

Truth is, those seas started out as seas of molten lava almost four billion years ago, only a few hundred million years after the Moon birthed from Earth. The early solar system was full of small and large objects from the formation of our star. The inner solar system was especially crowded with “stuff” so close to the great solar gravity field.

A Mars-sized planetoid smashed head-on into Earth very early on.[7] Several hundred million years later another large (but much smaller) asteroid hit the newborn Moon in an area near its south pole.[8] That lunar collision was likely at an angle of approximately 30 degrees, and at a slower impact speed than the dinosaur killer, as debris nearby is crustal without deep matter.[9] The lunar impactor nevertheless transferred extreme amounts of kinetic wave energy that heated the core, leading to eruptions of magma on the opposite side, forming the maria we know and love.

The moon was only partially resurfaced, and only on the side facing Earth. Venus was fully resurfaced in a sequence of events that only could follow the head-on impact of a dense object much more massive than the dinosaur killer. The Venus impactor was not as large as the Mars-sized object that directly created our Earth-with-moon, but still large enough to create V = H.

Our early impact ejected a huge “lava-lamp” magma blob, some of which returned to the Earth by way of gravity, and some of which collected into a spherical moon which then cooled. This event saw much kinetic energy sent into space.

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7 https://www.space.com/moon-formation-impact-earth-magma.html

8 https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GL082252

9 https://www.livescience.com/dark-side-crater-impact-unexplained.html

Briefly, *in ascending order of kinetic mass*: dinosaur impactor; lunar impactor; Venusian impactor; Mars-sized impactor.

Briefly, *in order of linear temporal sequence*: Mars-sized impactor; lunar impactor; Venus impactor; dinosaur impactor.

Unlike Earth, the moon is not massive enough to host a huge, persistently radioactive, metallic core. Venus could be, but that alone would not be enough to create V = H. Earth did develop planetary tectonics, and over time our tectonics reworked the surface. Venus saw most of its previously life-friendly surface vanish under molten magma flows billions of years after the original magma started to cool.

(4b) The great Venusian impactor

Whereas the Mars-sized Earth impactor had blasted apart the proto-Earth, creating our moon – Venus' impactor was not as massive, which allowed its kinetic energy to remain deep inside. Unlike the slow radioactive decay deep within Earth, Venus' new core energy swiftly erupted into a huge number of heat-releasing volcanoes spewing super-heated magma full of sulfur compounds.

It is important to note that there was no period on Earth seven hundred million years ago of "soaring solar heat." Therefore, the flashing-hot-sun thesis fails for such a short-term event. What may happen within our ordinary star's nuclear furnace a billion years from now is irrelevant to what happened to Venus some seven hundred million years ago.

Today we can see the remnants of an impactor on the moon that partially refaced the moon on our viewable side. The vector direction of kinetic energy pushed heat in that direction, melting deep areas of the moon, but not the moon itself. Only the much more massive Mars-sized impact four billion years ago melted its target, which of course allowed for the formation of our moon.

We are left with an intermediate sized impactor much larger than the one that supercharged the already ongoing volcanism in the Deccan traps. The total effect 66 million years ago was good enough to eradicate the great dinosaurs, but not enough to kill all the ground-dwelling birds and other sheltered species. Earth was allowed to return to a transformed and vibrant ecosphere after a few million years. Chickens we now eat are relatives of T-Rex.[10]

In a fully alternate reality, *if* the asteroid that hit us 66 million years ago had instead blasted Venus almost seven hundred million years earlier – *and if* the larger Venusian impactor had instead found our planet – *then* Venus could still be harboring life, and dead Earth would be Hell.

In a partially alternate reality, we humans, following the actual dinosaur-killer, might not have emerged; but some form of fairly advanced life would be here nevertheless. Combining the unique dinosaur-killer impactor and the ongoing Deccan traps eruptions, only opened evolutionary doors for a new cast of curious species, primarily our ancestor mammals.

The genetic potential within early mammals, combined with a temperate climate aftermath in a still vibrant ecosphere, allowed our species to dialectically emerge from apes over a few *million* years – and now to blindly and vigorously race toward unforeseen self-extinction[11] in only a few *hundred* years.

It is therefore supremely ironic and tragic that the legacy of our industrial Malthusian Anthropocene period will likely be the survival of some species of curious simple life – but not the misnamed *Homo sapiens*.

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10 https://www.cnn.com/2019/10/04/world/dinosaur-meat-taste-scn/index.html

11 http://astronomy-links.net/Unforeseen.Extinction.pdf