Matt Gubancsik

The Cosmological Sublime

Hubble's Images and Romantic Landscape

New Visual Studies
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Since first seeing them in high school science classes, astronomical imagery, like those from the Hubble Space Telescope have filled my imagination with a perceived truthful understanding of the universe. I fell prey to the natural tendency to accept that photography's seemingly indexical connection with its subject matter lends viewers of the medium a transparent view of something existing that way in their universe. I felt that the images from Hubble were extending my, and humanities, collective vision of what was its next frontier of exploration: space. Hubble, and other space imagery, had also allowed me to gain a measure of perception of my world from without. My mind used the proliferation of these omniscient-seeming imagery of the Earth to construct a mental picture of myself in the greater picture of the known universe. After seeing the amazing images from Hubble like the first Eagle Nebula shot in 1996[i], sometimes known as the pillars of creation, I felt that they had extended my vision. I looked up at the night sky and felt that those sights were up there as I had seen them in the magazine, and if only I could zoom in far enough they would be there. It turns out I was mistaken. As with any photograph, the subjective power of the hand of the people directing the camera, capturing, and manipulating the image cannot be forgotten. Capturing accurate high resolution color images of far distant astronomical phenomenon is a convoluted, and in some ways, impossible task. The light that travels through space so far from these places has degraded so much that even with fictional "perfect" telescopic equipment, one that could amplify the light of a nebula enough for a human eye to view comfortably while looking through the telescope in space, the best a human eye could see would be a dim fuzzy scene with little color beyond perhaps some pale greens. To create the breathtaking space imagery I've come to take for granted and be inspired by, astronomers have to take a great deal of subjective creative liberties. While based on accurate scientific data from instruments like Hubble, the manner in which they are translated can often

be completely arbitrary and based on aesthetic concerns far more than scientific ones. These space images, that have shaped our cultural impression of the cosmos, are greatly influenced by the visual elements of the sublime landscape and parallel the intentions and romantic tropes of 19th century American West landscape painting, a correlation that only enhances their innate sublimity.

The Hubble Heritage Project is a quintessential example of a group of scientists constructing astounding imagery of the cosmos through somewhat incidental means. The goal of project is to utilize the Hubble Telescope (around 1% of its time to be precise) to find and capture beautiful and sublime astronomical sights and share them with the general public. The outcome goal of these images is to stimulate interest and support (both monetarily and not) of the sciences in general and in Hubble specifically. A small team of 10 astronomers works to create these images at a rate of around one per month.

It is a very involved process to create these grand shots[1]. After selecting a phenomenon that is both visually interesting and that they are able to photograph in high quality, they capture several shots of the scene with the Hubble's visible light camera known as the Wide Field and Planetary Camera 2 (WFPC2). Hubble actually has four different cameras. WFPC2 and the newer higher resolution Advanced Camera for Surveys (ACS) captures visible light like a standard cameras. Another, reads ultraviolet, and the fourth sees in the infrared spectrum. The visible light camera captures imagery by directing the light through a serious of mirrors that projects what the telescope is seeing onto four different digital charged-coupled device (CCD) sensors, the same type of sensors that digital cameras use instead of film. Unless the image

[1] I gathered most information about the Hubble image construction from the Hubble Heritage website, the Sky and Telescopes article, and from Kessler's text, respectively.

processor staff combine additional shots to get rid of it, single shots from the telescope come out with a tiered corner, creating an image frame that looks like a stealth bomber. This artifact is created by the fact that one of the four sensors is set up for a higher magnification than the others, for additional detail. Then, in processing, this magnified forth quadrant is scaled down to match the scale of the other 3 quadrants. Hubble has granted us a far greater view of the cosmos than ever before, having a telescope outside the obscuring effects of the atmosphere. It has several limitations though.

First among its limitations is the fact that it is only capable of capturing images in black and white. Color is added to the images in post-processing on the computer. Second, Hubble cannot orient itself towards the sun as, without the protection of the atmosphere, the extreme radiation would destroy the sensitive recording equipment. In fact, it can't even view Mercury or Venus because they are too close to the sun. The Earth also plain gets in the way sometimes, limiting viewing times on certain phenomena.

Applying the color to the Hubble imagery is an involved and sometimes controversial process. There are several different ways Hubble image processors render color into the black and white raw images. The foundation of the process is that astronomers capture several different exposures of the same scene, color each image a different, usually colors like red, green, and blue, and merge these different shots together in Adobe Photoshop. This results in a seemingly realistic, though ultra-vibrant, full color image. The accuracy level of whether a nebula would look like the Hubble image if you were to visit it in a space ship varies. In some instances the astronomers can garner a good idea of what the color would look like based on the materials they have discerned make up the celestial objects. They know how certain elements will absorb and reflect light at certain wavelengths produces specific colors. According to

Hubble's website, "Nebulae glowing with fluorescent clouds of hydrogen, oxygen, and nitrogen are nature's own version of a honky-tonk strip of neon lights. Because thin gases glow only at specific wavelengths, these colors are pure, distinct, and very saturated" (Sky and Telescope 31). The visible light and infrared cameras have many filters they can apply when capturing images. Some of these filters allow only wavelengths of light reflected from certain elements to pass through to the camera. Thus, they can take additional frames to merge that only show the doubly ionized oxygen that is in the nebula that they know would look blue-green, or neutral hydrogen that would look red. They color these frames accordingly and merge them in. Some images should be rather accurate to real life then. In fact, with some imagery that they create the color through this method, like that of planets, they can double check their work with earth based telescopes that can see the color. Deceivingly, some images derive their color from non-visible forms of radiation such as degrees of heat, like in Planetary Nebula NGC 3132. So the viewer gets an impression of the phenomenon where the colors are arbitrarily assigned to different degrees of temperature.

Beyond color, the merging process changes the raw black and white shots in several ways. First, if several shots are taken to get a wider field of view and higher resolution, computer software and manual alignment is used. Then artifacts have to be removed. There are lines that cross the frame from the gaps between the CCD sensors. Combining multiple exposures that are slightly different views can allow the software to fill in the gaps. Combining multiple exposures from the same angle is also always necessary because without the protective barrier of the atmosphere, random space particles pass through the Hubble's outer layer and strike the CCD sensor while the image is exposing, leaving light dots and streaks all over the image. The online documentation makes this process seem all automated and thus realistically

accurate. Yet watching a time lapse of the processors working with the image, I noticed how much clone stamping and other Photoshop techniques were used to cover up capture errors, or otherwise fill in areas with data that the computer is generating independently of any actual cosmological observation. Then, the processors combine the different color exposures and make liberal use of color adjustment layers and contrast and curve adjustments to create an image that conforms to modern standards of a high quality photographic image, with vibrant colors and a wide dynamic contrast range with pure blacks and pure white and lots of mid tones values (Sky and Telescope).

These type of "promotional" images receive varying receptions. Many scientists dismiss them as "merely pretty pictures" despite the fact the same astronomers perform their work in offices decorated with these types of imagery (Kessler 9). Elkins dismisses the value of these "pretty pictures" also, more interested in the informational images that the astronomers gather data from. While Elkins, looking at the non-art oriented imagery that astronomers make, still finds an emphasis in them on aesthetics. According to Elkins it is the efforts scientists make at refining their informational imagery is aesthetics in its original form, a "pre- Kantian sense of aesthetics as the "perfecting of reality"- the very doctrine that governed Renaissance painting" (Elkins 558). He cites the post-capture cleanup of the raw black and white imagery that the scientists use even for just their informational images. In his example from the Harvard-Smithsonian Astrophysical laboratory, the fuzzy, digitally noisy, cosmic ray-streaked, black and white image is still aesthetically perfected as the scientists remove spots, streaks, and other artifacts from dead pixels, cosmic rays, dust, and even epoxy on the sensor before they are utilized for scientific analysis. Their motivation is "[…] to make their images the most rational version of phenomena" (Elkins 559) He remarks that the scientists, as opposed to artists, make

the greatest emphasis on elegance, clarity, and simplicity. Yet, Kessler, the author of *Picturing the cosmos: Hubble Space Telescope images and the astronomical sublime* argues that the "pretty space pictures" are valuable beyond simple aesthetics because they have had a profound influence in shaping our cultural imagination. I greatly agree. Beyond aiding greatly to the visual experiences of entertainment such as science fiction, they have allowed humanity to better visualize the universe that they are a part of. They have added a wealth of rich visual imagination to the collective cultural visual model of our existence. In growing up, no other imagery, despite perhaps illustrations of Dinosaurs, inspired in me such a sense of awe at the vast mystery of the universe. The illustrations of Dinosaurs, showing that such bizarre, mythological seeming creatures actually roamed and ruled the same land and breathed the same air I inhabit, seemed to grant the universe a greater sense of mystery and wonder. The Hubble images produce in me a similar sense of wonder, but one for an inspiring future where perhaps humanity will visit these celestial sites.

The nature of the subject matter of the Hubble images themselves, in concert with what the astronomers at the Hubble Heritage Project choose to document and in what fashion, makes use of a series of romantic painting elements, giving these extraterrestrial images a sublime and relatable appearance. Kessler makes some very intriguing analogies between several of the Hubble Heritage Images and several romantic landscapes. The selection and framing of these celestial objects, along with the mediated process of enhancement for an aesthetic or emotional reaction of a new frontier, seems to parallel greatly the Romantic sublime landscape paintings of the American West, both consciously and not, that rely heavily on Kant's description of the sublime. "The Mythos of the American frontier functioned as the framework through which a new frontier was seen" (Kessler 11). Images such as The '96 Eagle Nebula image, are framed

and orientated in such as way that they reference towering eroded rock spires, but also a roiling cloud formation. It thus appears familiar, yet so alien, like the grand painting of the *new world* would have appeared to Western eyes long ago. The Romantic paintings like Thomas Cole, Bierstadt, and Moran, and that of the Hudson River School worked in a similar mode as the modern astronomers do. Their stated mission was one of documentation. They made first hand observations of a new frontier to bring back a *view* of a new world. Yet, through the process of creating their imagery they exerted creative license, altering and enhancing their imagery to convey to their audience a view of their experience that was a tad more visually impressively overpowering than their audiences own eyes would have scene.

The history of Thomas Moran curiously parallels that of these astronomical images. He was the official artist with the first survey of the Yellowstone region. He created breathtaking sublime landscapes of the West. He, along with the other painters of the Hudson River School, took great liberties with enhancing the paintings of the landscapes they were *documenting* the American West with to make it appear as sublime and aesthetically pleasing as possible. Some of these paintings had an overpowering scale themselves of more than four meters wide. When his paintings returned East, they grew vast crowds of awed spectators. To them, the paintings were showing them what was actually beyond the horizon, a place that really existed, seemingly beyond imagination (Miller 141). The public audience was as believing in the transparency of the '96 Eagle Nebula image when it came out, as their ancestors had been in the 1870's.

A good example from another Hudson Valley School painter Albert Bierstadt illustrates the way that landscape was depicted. In *A Storm in the Rocky Mountains*, an infinite immensity of a mountain range is depicted by painting a vast mountain range that disappears into the distance and is cropped at the side and top of the image, implying that it extends well beyond the

frame and a peak of the mountains is even rising up through a gap in the clouds so that it feels like the vastness of the new world extends forever, even into heaven, reminding the viewer how small they are by including tiny native Americans in the valley below.

Slight alterations of detail for a more desirable aesthetic effect haven't always been done by painters. William Henry Jackson, in 1892, created the photograph *Mountain of the Holy Cross* which depicted a mountain in Colorado with two ravines filled with snow that seemed to form the shape of a cross. When he was processing the plate in his mobile darkroom, transported by donkey, he took the creative liberty to fill in one arm of the cross so that is was symmetrical. Leaving viewers of his work woefully disappointed when they eventually visited the site in person to find that it was a cockeyed cross in real life.

A somewhat similar traditional of landscape creative licensing can be seen in the panoramic maps of Heinrich Caesar Berann. An artist and designer by training, turned cartographer, he painted nearly 600 maps before his death for tourist resort map publishing firms and government agencies. He specialized in *Panoramic* Maps that showed a vast area from a great height with features of the landscape altered in various ways to convey the *true character* of the area. A great examples is his *Greater Yellowstone* map[ii], one of a series of maps he did for the U.S. National Park Service between 1986 and 1995. Compiling photo references from various aerial surveys his took, he painted a *map* of the region that emphasized the key characteristics of the region. He oriented his map facing south, the better to view what he wanted to feature. Some features like the Old Faithful Lodge and Teton Range were exaggerated in size to place emphasis, and the Tetons themselves were turned 180 degrees as they would appear normally as to show their east face which was more recognizable. Such manipulations in the Hubble imagery is fortunately not so blatant, but after seeing the original composited images,

it is hard to deny that the processors take liberties to emphasize what area they feel are important to the success of the image.

Kessler makes intriguing note of how the Hubble Heritage Project images visually reference these paintings. She points out how the astronomers, when they choose astronomical phenomenon to photograph, zoom in, cropping to a specific section of the nebula that remind us more of earth landscapes. The images carry the name of the celestial object they are a part of, like the '96 Eagle Nebula image, even though nebulae are named as self-contained objects when zoomed out so you can see them as a whole, with visual names like whirpools, eagles, crabs, ect.

Traditionally, astronomical images are oriented so that north is at the top of the image and east is on the left. So you are viewing it as if you were lying on the ground with your head facing north holding a very, very powerful telescope....the size a large automobile. The astronomical image processors often disregard this, so that they can create a greater sense of a landscape by orienting gaseous shapes so that they reach upwards like mountains and place the lightest part of the image at the top of the frame, as if the shapes are reaching up towards the bright sky such as in the Cone Nebula[iii], the Keyhole Nebula[iv], the Trifid Nebula[v], and the '96 Eagle Nebula. She notes how all of these images also make have lighting that mimics the *golden hour* landscape late as the sun dips towards the horizon and make colors vibrant and would backlight mountainous shapes like these with the rim lighting almost divine aura. It seems to highlight and isolate the individual shapes, making them seem more a solid tangible object than a gaseous cloud.

She compares the 96' Eagle Nebula with Thomas Moran's *Cliffs of the Upper Colorado River, Wyoming Territory*, 1882[vi], as a quintessential example of how the Hubble images parallel in light, color, and composition many of the Hubble images. The resemblance is somewhat

uncanny. In this image there is a view of towering rock columns with illuminant gradient colored faces that seem to glow with light. Beyond the towers are frothy, colorful clouds, similar to the hazy wisps of gas that surround the Eagle Nebula columns.

The image makers were evidently aware of the similarities with the American West. In a press release concerning the image of the Cone Nebula it is described it as a "craggy-looking mountaintop of cold has and dust." In a 1995 press release the scientists try to make the process of creating a new star, called photoevaporation, within the Eagle Nebula more understandable by calling it "analogous to the formation of towering buttes and spires in the desert of the American Southwest" (Kessler 38).Which is kind of what the pillars of gas that have been weathered away by intense ultra-violet radiation look like already. Howard Bond, one of the higher ups at the Heritage Project, leaves some subtle clues about whether or not they are aware of the connections they are making. At the bottom of his website profile he has a picture of him standing in front of one of his teams nebula images, then below it he has another picture of him standing next to the quintessential sublime painting *Monk by the Sea* by Caspar David Friedrich. Then, tiled in the background, he has Friedrich's *The Sea of Ice*. He is calling attention to a parallel between his work with that of Friedrich's.

When I noticed the image *Star-Forming Region NGC 3324*[vii], I couldn't help but feel an immediate connection to the American Western landscape Keeler describes. The image is oriented so that the bottom half is composed of what looks like a rather solid shape of a rusty reddish cloud bank, very similar to the colors of the rock formations out West. It has this golden rim lighting also. The top half of the image very much resembles a sky. It is even blue with translucent gaseous formations that looks like clouds and is more transparent than the *mountain* shape below, allowing more stars to shine through like a night sky. The orientation of the

celestial object lends the impression of a clear horizon line with the light source seeming to come from the top of the image.

The Hubble images try to convey this same sense of depth. Several of the images utilize coloration and lighting that give them an illusion of atmospheric perspective, such as this 1995 image of the Orion Nebula[viii]. Here the lighter haze in the middle conveys a sense that the subject matter there is deeper within the frame than the darker, less hazy gases around it.

Many of the astronomical images seem to make direct allusion to sublime landscape paintings, but I would argue that all the images that the Hubble Heritage Project have created are inherently sublime. As in the *Monk by the Sea* by Caspar David Friedrich, we are the diminutive figure, when looking at these space images, we are confronted with the reality of the physical vastness, power, and super-sensibility of the natural world that towers above us. This realm is at the same time beyond our reach, but because of our intellect and technology we believe it is within our system of understanding. Even images that don't have an intense visual presence like the '96 Eagle Nebula image, that I feel I can place myself before, they still have a sublime effect on me based on the understanding of the subject matter because I can feel myself standing on Earth with these gargantuan forces above me. When I look at them, images of gaseous towering Nebulae or tiny spirals that are entire galaxies, I experience what Edmund Burke and Emanuel Kant attribute to the experience of the sublime: the temporary suspension of the power of reason as my mind tries to grasp the immensity of the universe and my place within it. Burke discussed how the seeming immensity and complexity of the night sky always prompted sublime contemplation of the infinite, and always would since it was beyond humanity to ever fully catalog and understand the heavens. At first reading of that I felt that astronomy was succeeding filling in the catalogue of the heavens, thus making it less sublime, but really every great

scientific space discovery I learn of actually increases the sublime appreciation of space because it reminds us how complex it is and how little we know.

When looking at these images I am reminded that to our understanding space is infinite, yet my reason will not allow me to picture a universe that has no limits, at the same time though, I can't picture a universe that has limits, what would be beyond the box of creation? Kant describes this tension between the sensory experience and reason as a chief factor in the power of the sublime namely, the temporary suspension of the power of reason. As Kant would put it, imagination, because it is based on the senses, cannot picture an infinite, while reason can conceive of it. Thus is the sublime tension is formed[2].

When I see a black field speckled with dots of light, such as in *Coma Cluster of Galaxies*[ix], that upon closer inspection are revealed as the pinwheel shapes of entire galaxies, I am jarringly reminded of my insignificance compared to the unending vastness of a universe where of magnified view from a telescope can see a cluster of galaxies, each could contain, like ours, 200-400 billion stars. It is remarkable how, because of the ingrained notion of photography as transparent, 1500 dots of light on my computer monitor can have such a profound impact on the understood perspective of my place in the universe. In the instance of this image, I don't believe the mediated nature has much impact on the profound statement it makes. Does it matter that the galaxies depicted in the image might not be the right color or contrast? The fact that this artifact has allowed us to get a glimpse into the utter immensity of the universe remains its value.

[2]References to the distinctions between Kant's and Burke's Philosophies originate from Kessler's text pgs.46-50.

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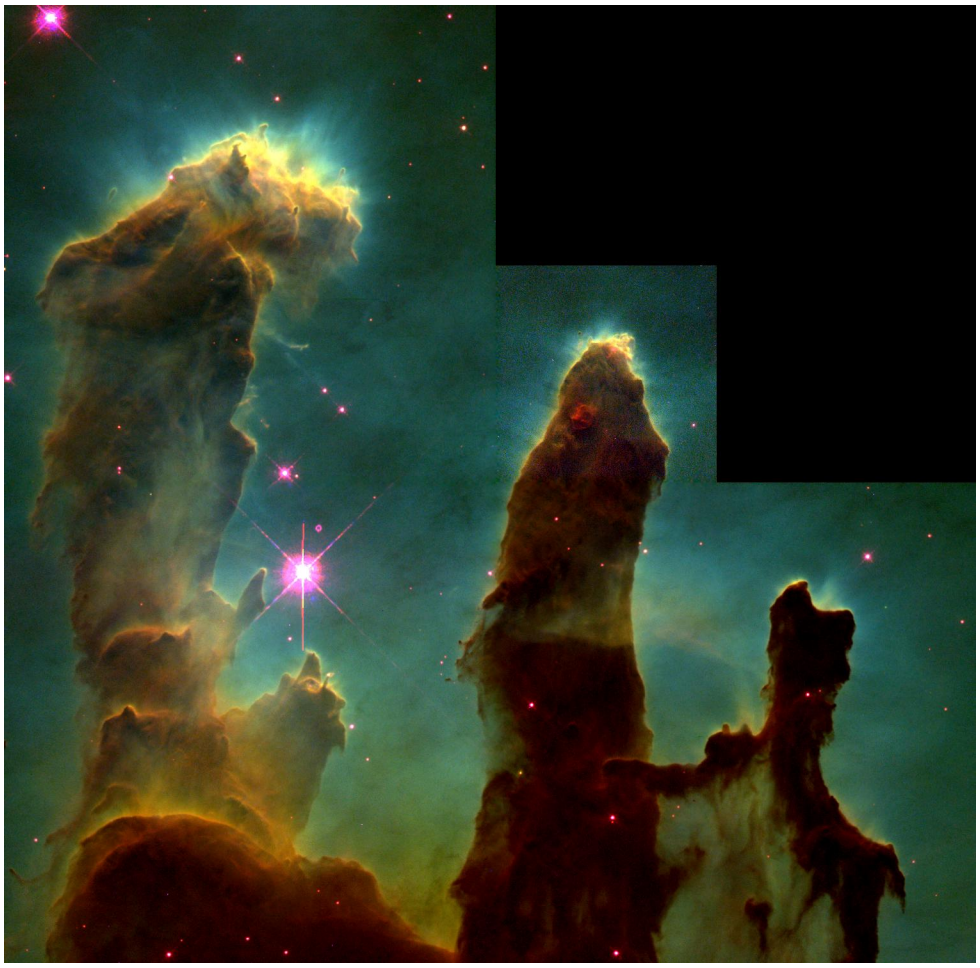

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Star-Forming Region NGC 3324
Hubble Heritage
NASA, ESA, and The Hubble Heritage Team (STScI/AURA) • *Hubble Space Telescope* WFPC2 • STScI-PRC08-34

vii

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The Cosmological Sublime

Matt Gubancsik

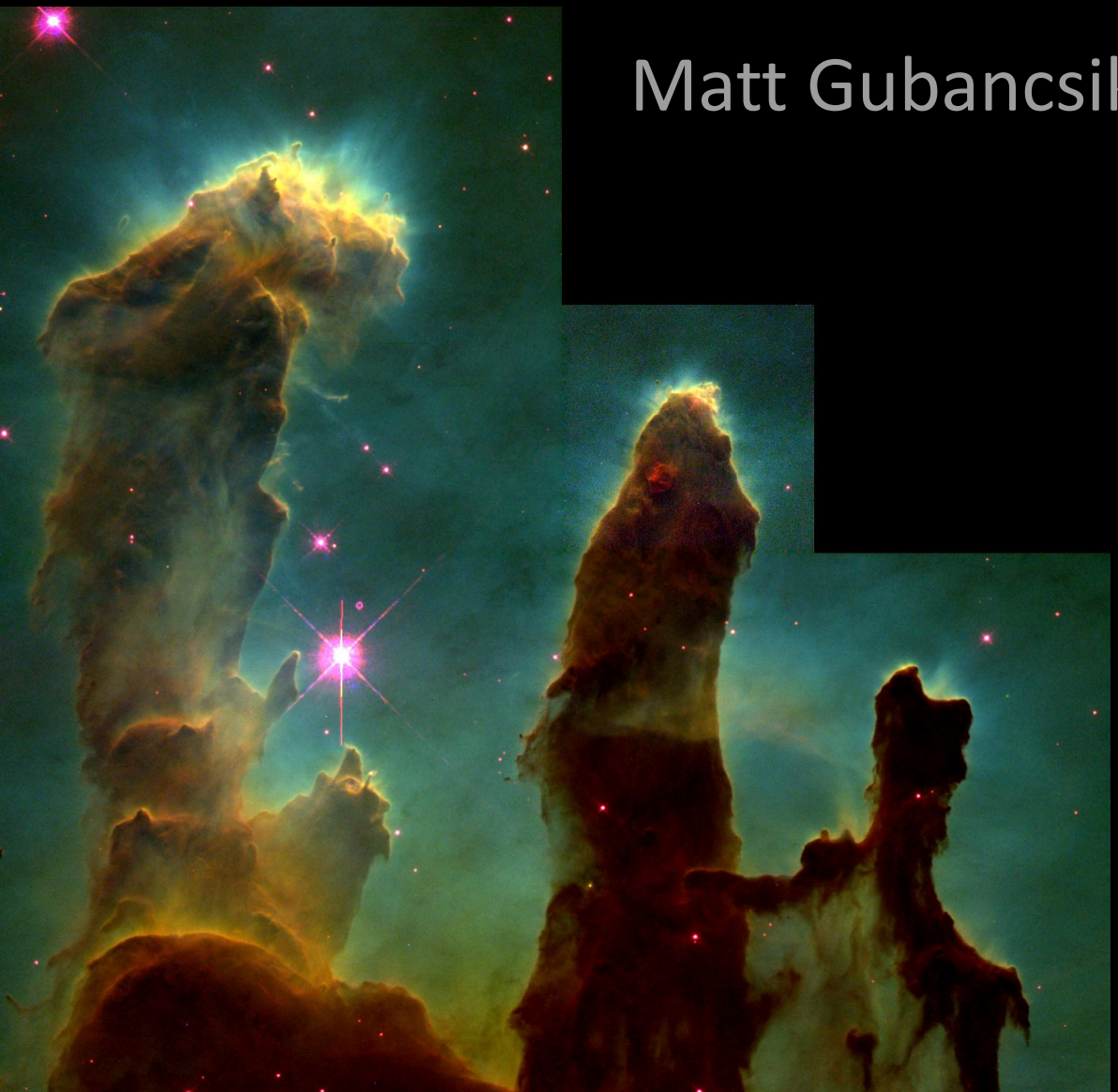
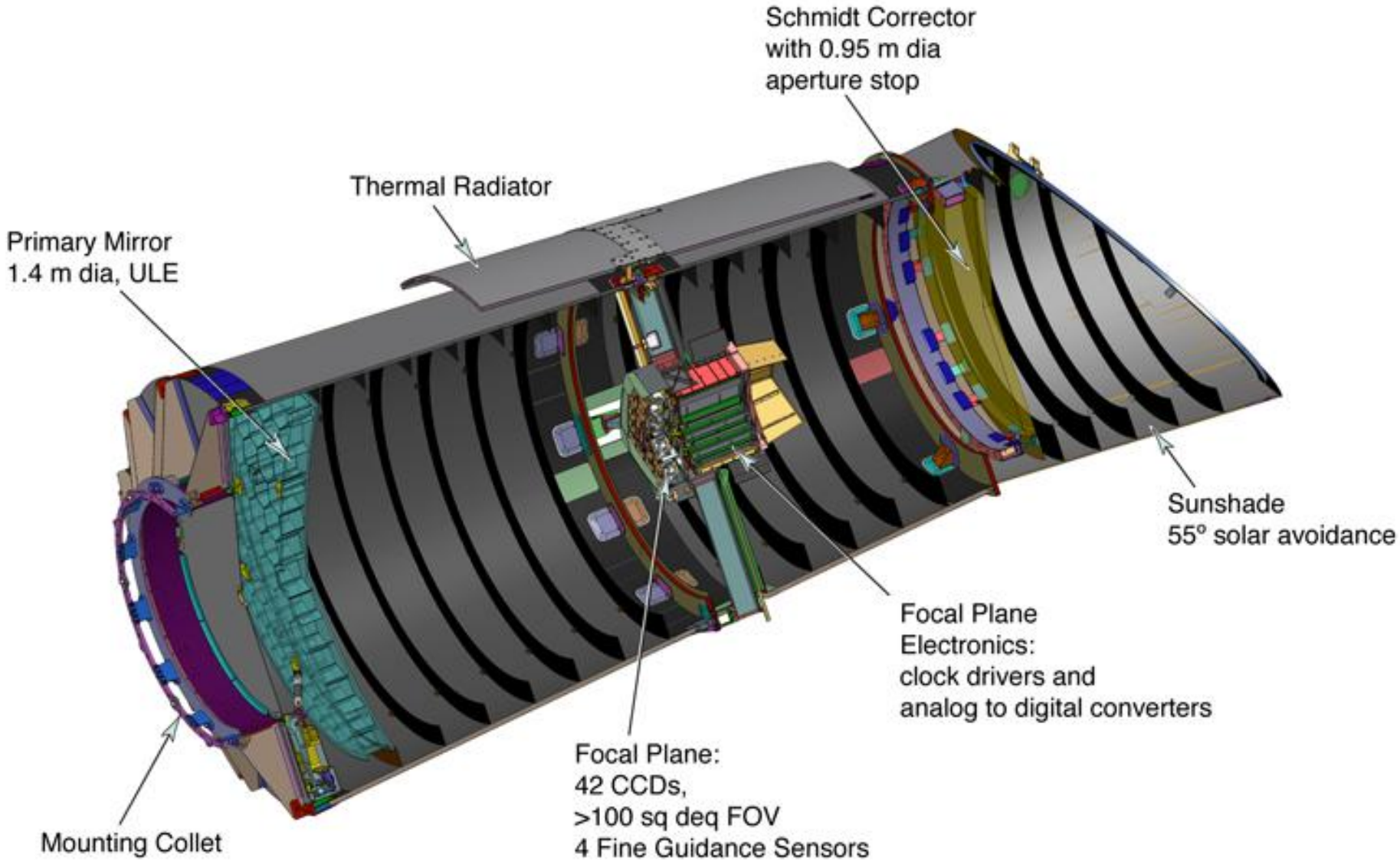


Plate 20

THE GREAT PERSEUS NEBULA


Schmidt Corrector
with 0.95 m dia
aperture stop
Thermal Radiator
Primary Mirror
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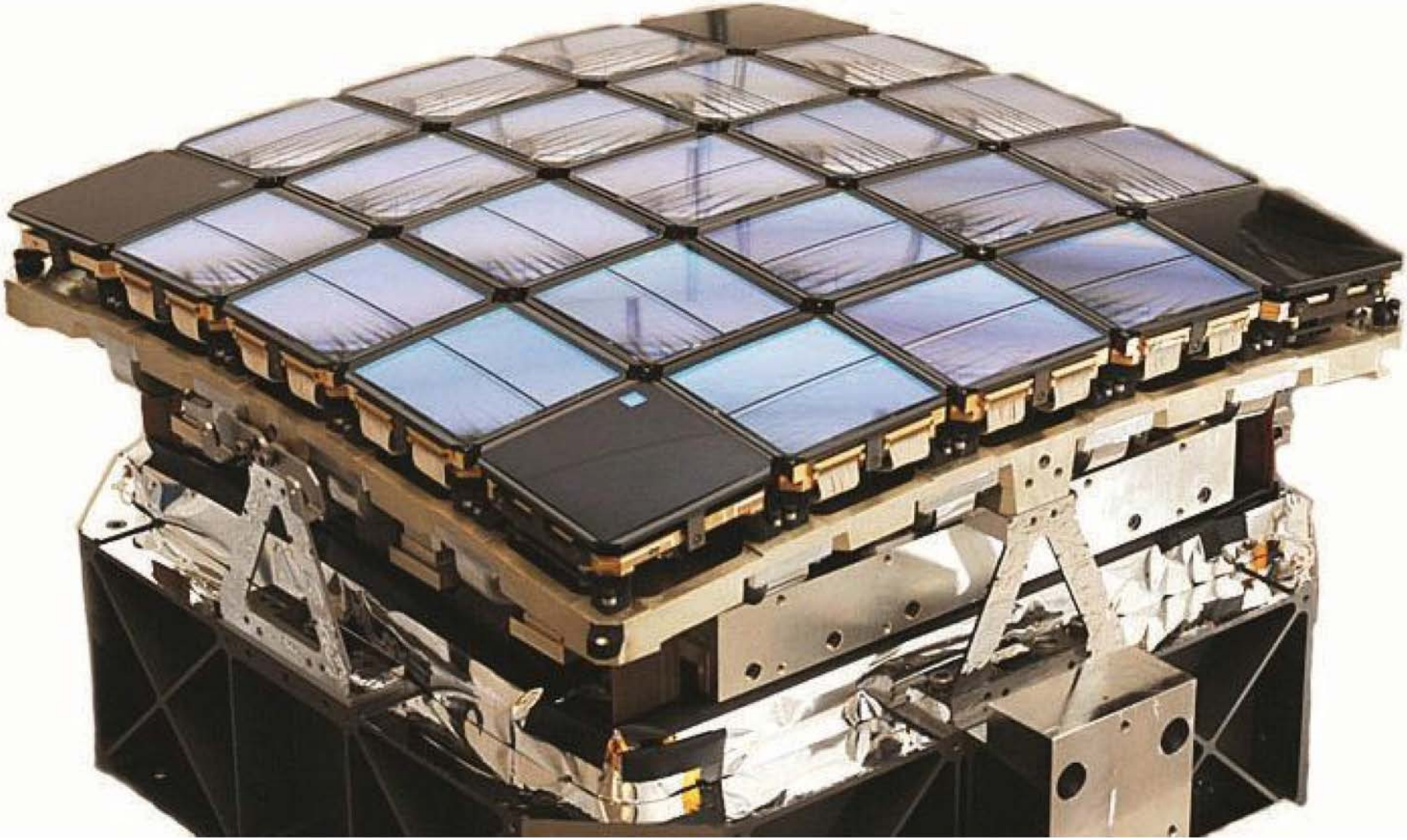
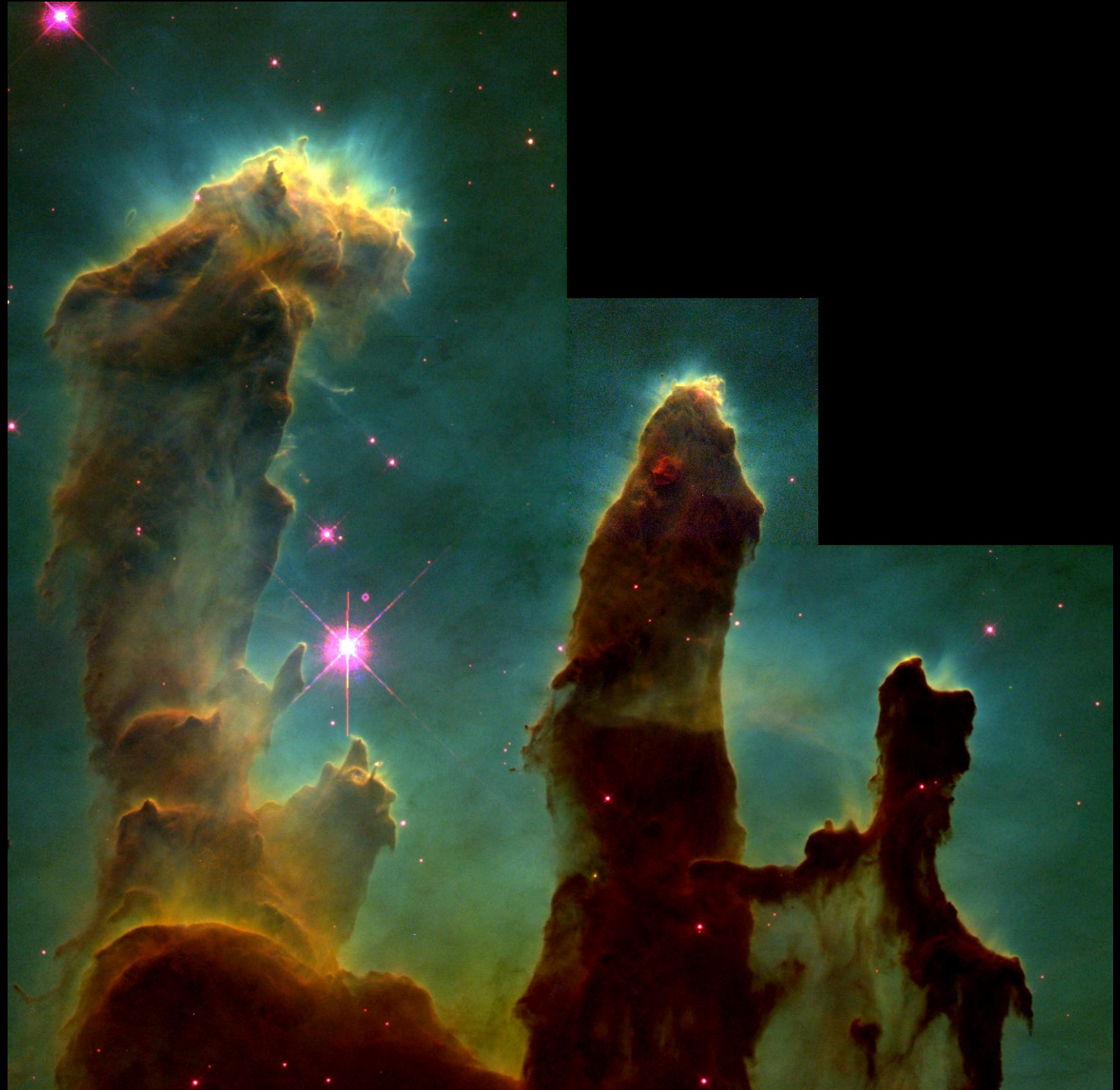
Sunshade
55° solar avoidance
Focal Plane
Electronics:
clock drivers and
analog to digital converters
Focal Plane:
42 CCDs,
>100 sq deq FOV
4 Fine Guidance Sensors
Mounting Collet



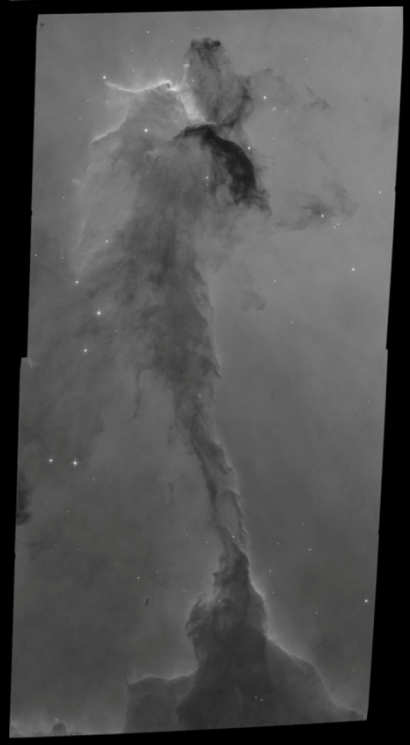


Eagle Nebula
M16

Hubble Heritage

NASA, ESA and The Hubble Heritage Team (STScI/AURA) • Hubble Space Telescope ACS • STScI-PRC05-12b




Eagle Nebula
M16

Hubble Heritage

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Planetary Nebula NGC 5189

Hubble Heritage

NASA, ESA, and the Hubble Heritage Team (STScI/AURA)
HST WFC3/UVIS • STScI-PRC12-49a

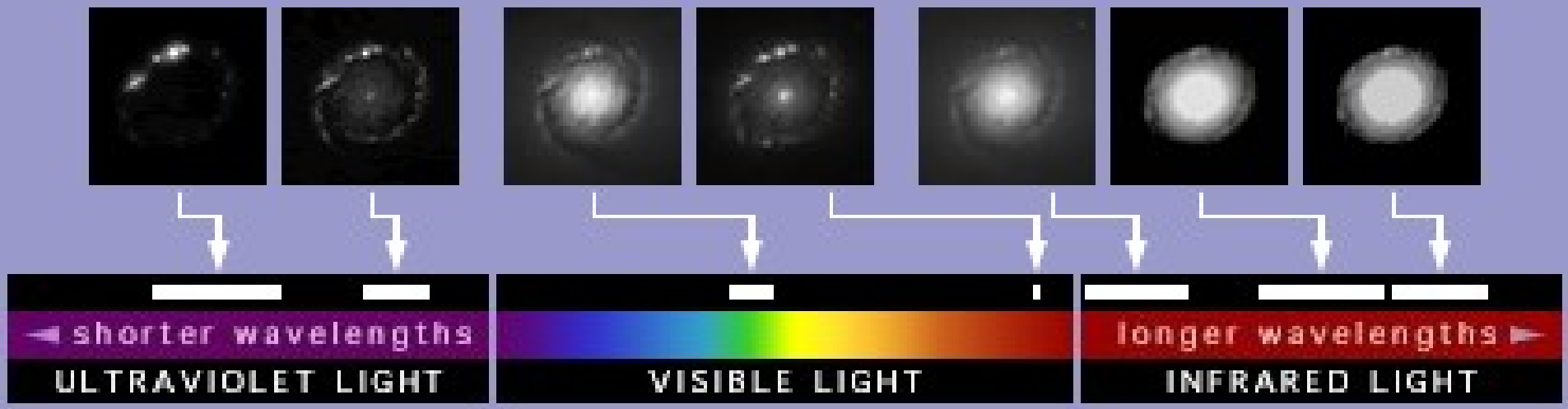
Planetary Nebula NGC 2818

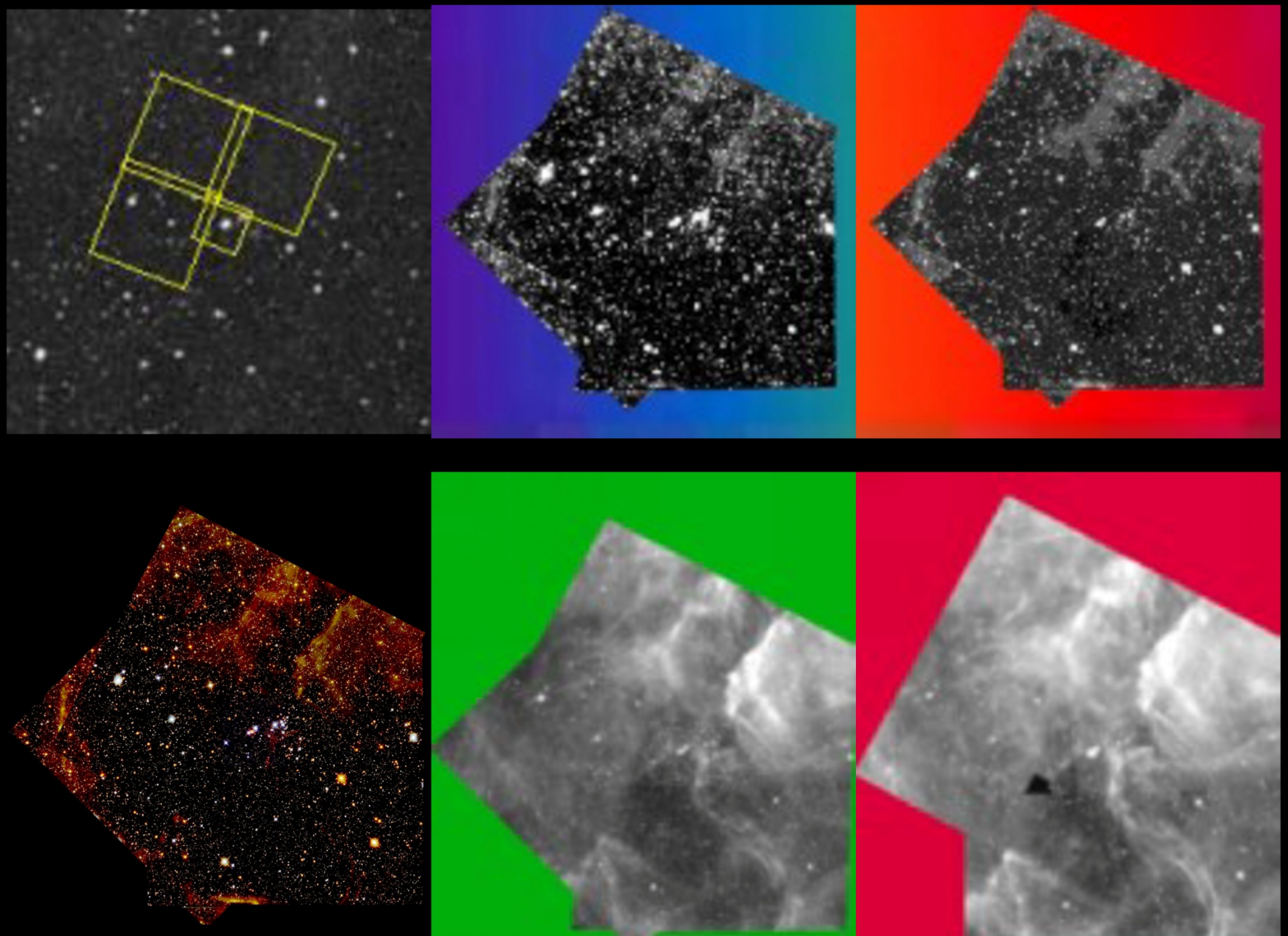
Hubble Heritage

http://hubblesite.org/gallery/behind_the_pictures/meaning_of_color/hubble.php

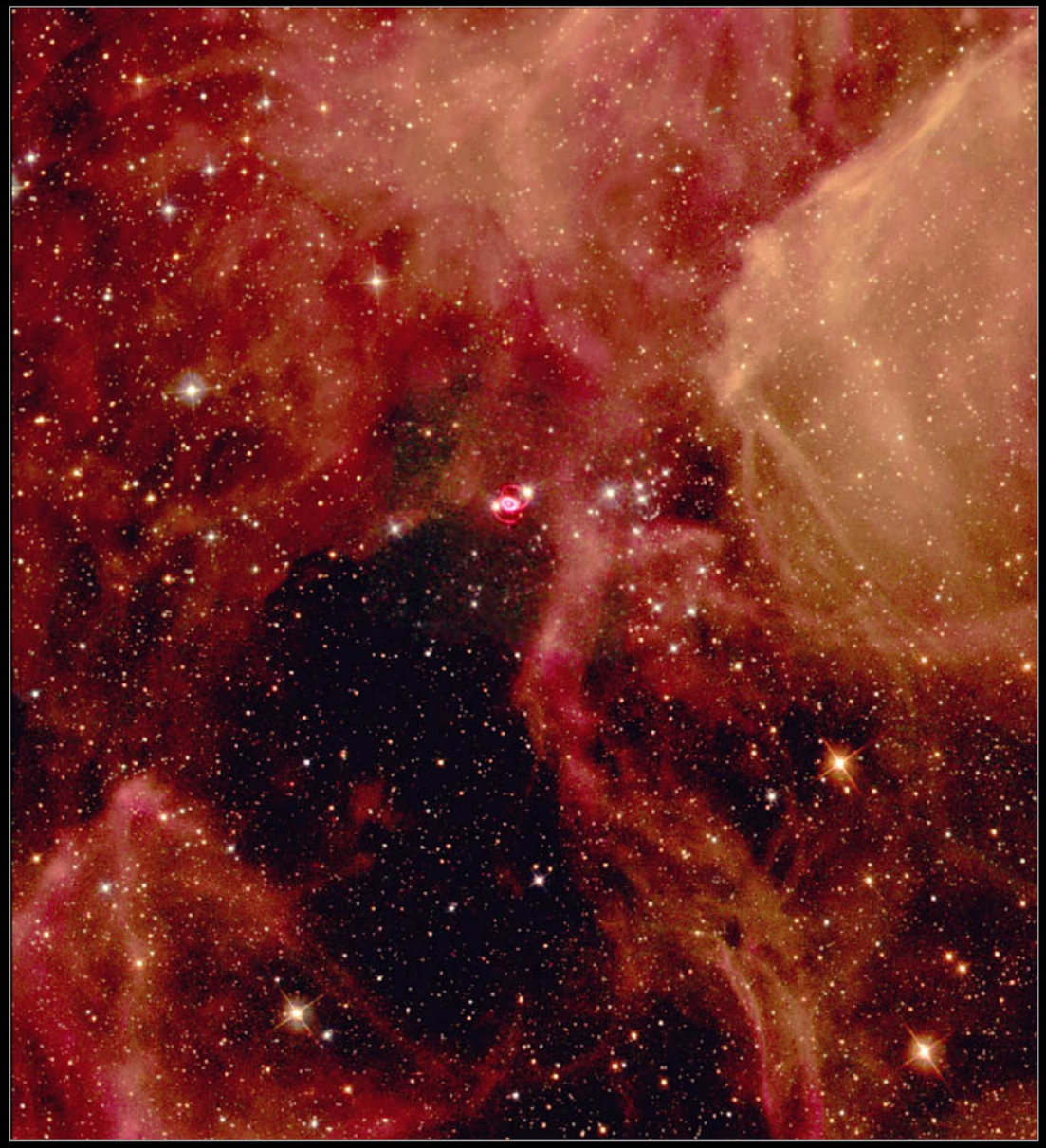
Light & Filters

The seven pictures below depict galaxy NGC 1512 in different kinds of light. Note how the individual images differ in appearance.





Supernova 1987A

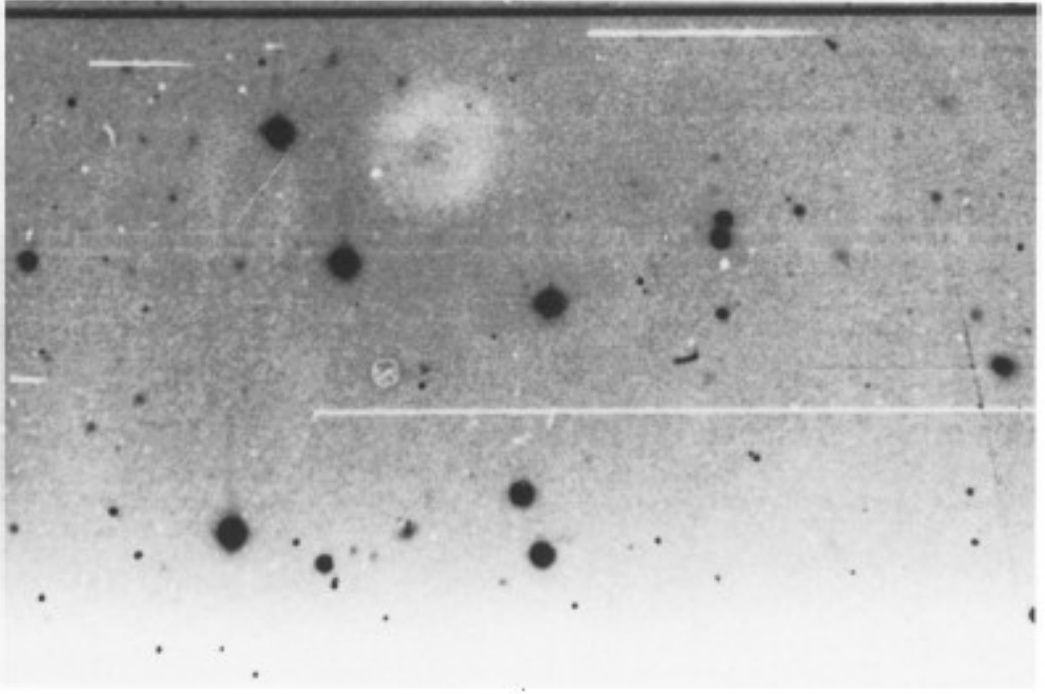


Hubble Heritage

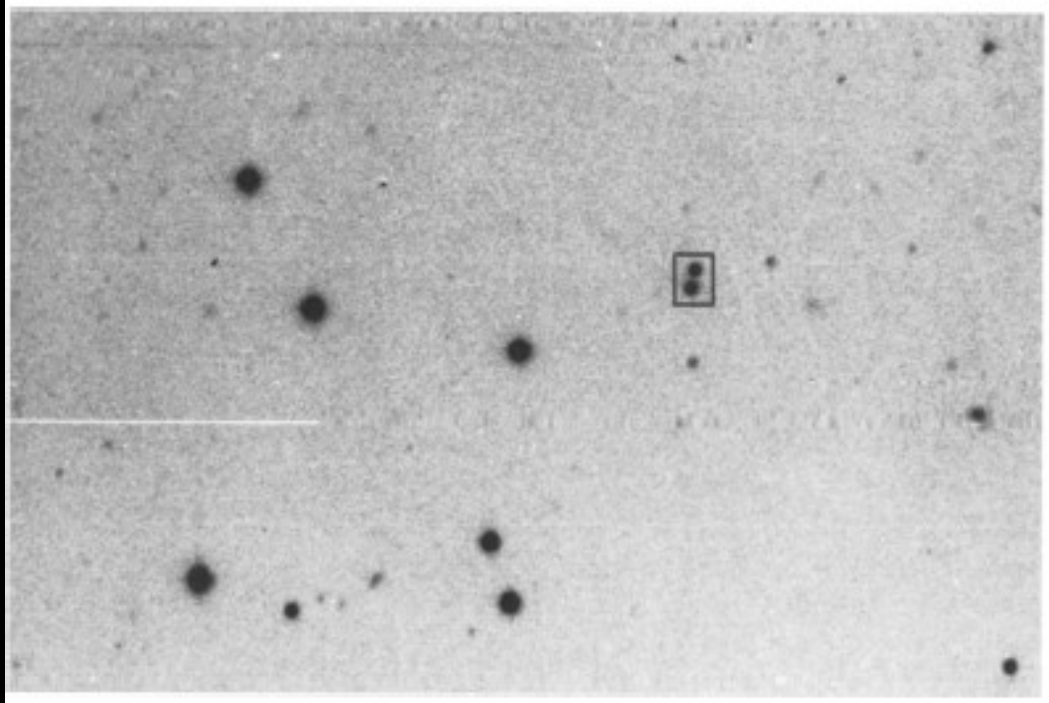
PRC99-04 • Space Telescope Science Institute • Hubble Heritage Team (AURA/STScI/NASA)

http://hubblesite.org/explore_astronomy/hubbles_universe_unfiltered/

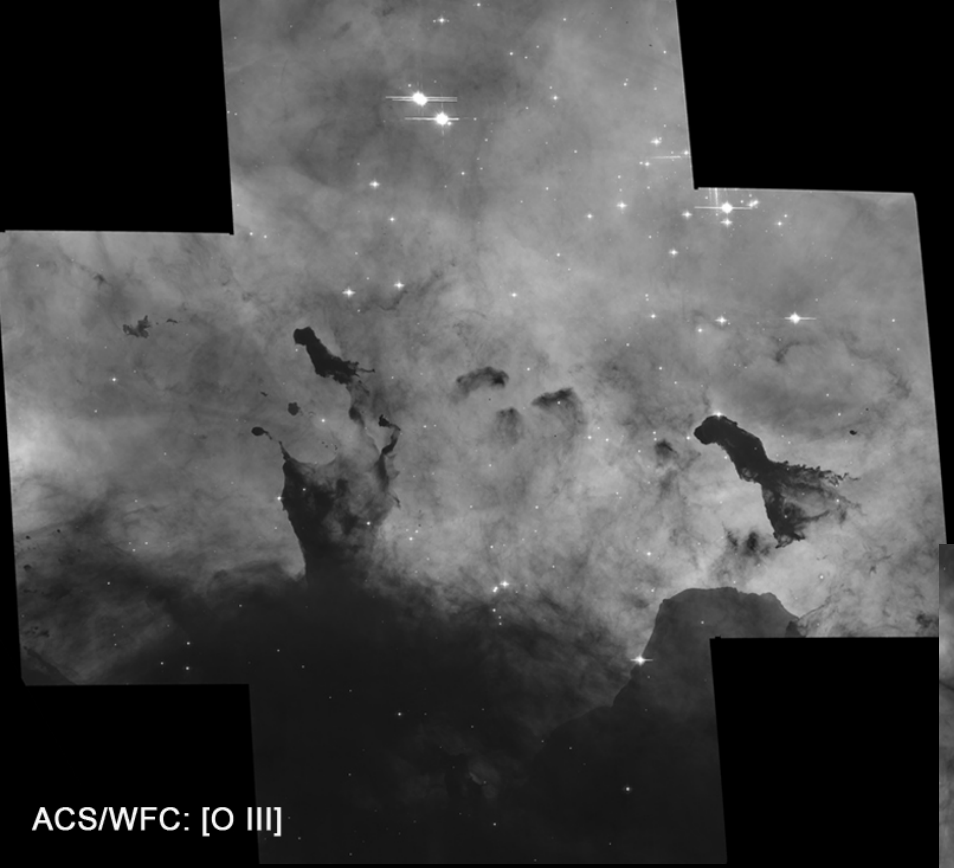
http://imgsrc.hubblesite.org/hu/gallery/db/video/creating_galaxy_ngc3982/formats/creating_galaxy_ngc3982_640x360.mp4



1 "Noisy" CCD image (from Michael Lynch and Samuel Edgerton, in *Picturing Power*, fig. 3; courtesy Michael Lynch and Rudolph Schild, Harvard-Smithsonian Astrophysical Laboratory)

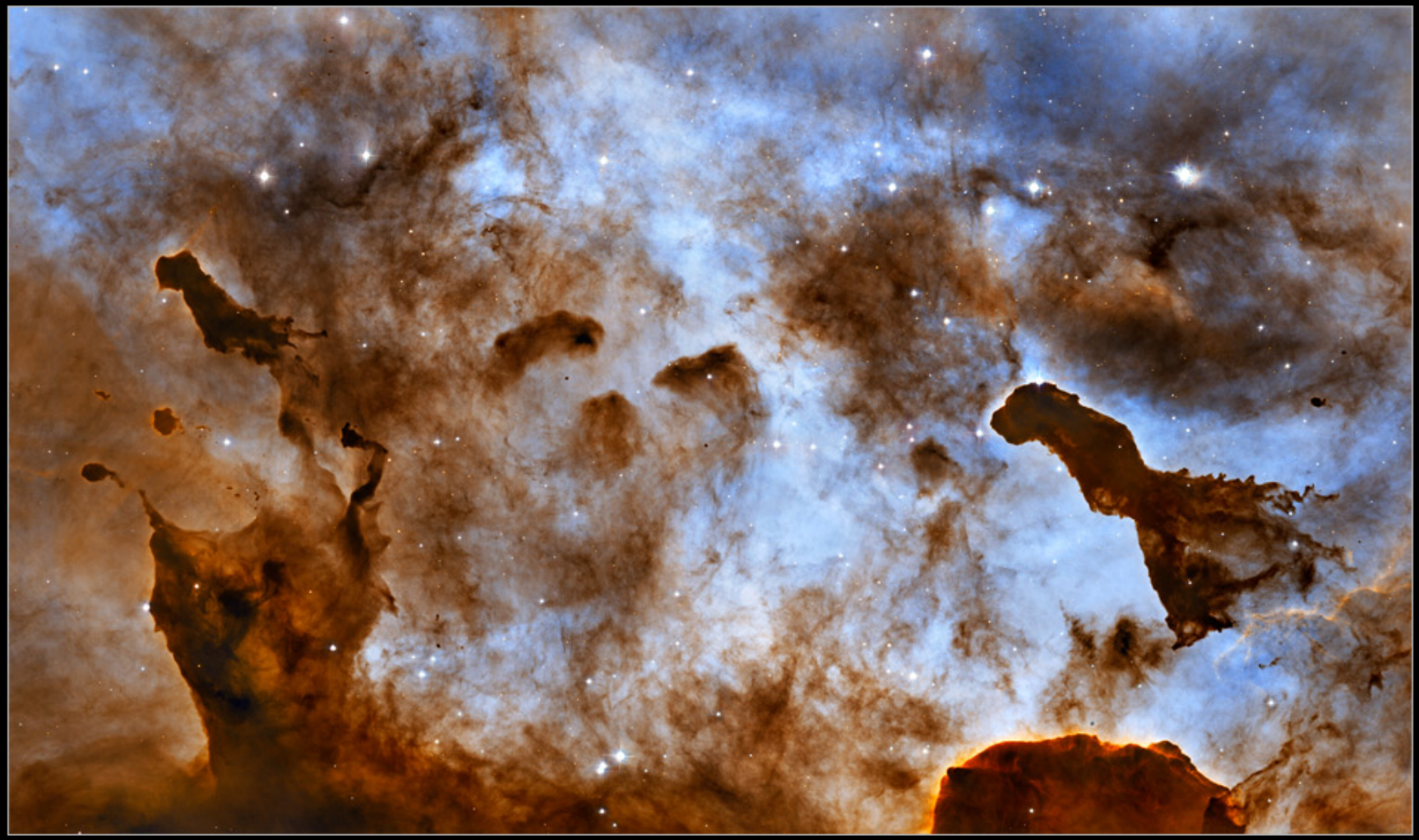


2 Processed image, with cursor box drawn around the object QSO 0957+561 (from Lynch and Edgerton, fig. 4; courtesy Michael Lynch and Rudolph Schild, Harvard-Smithsonian Astrophysical Laboratory)


ACS/WFC: [O III]


ACS/WFC: H-alpha

Carina Nebula



Hubble Heritage

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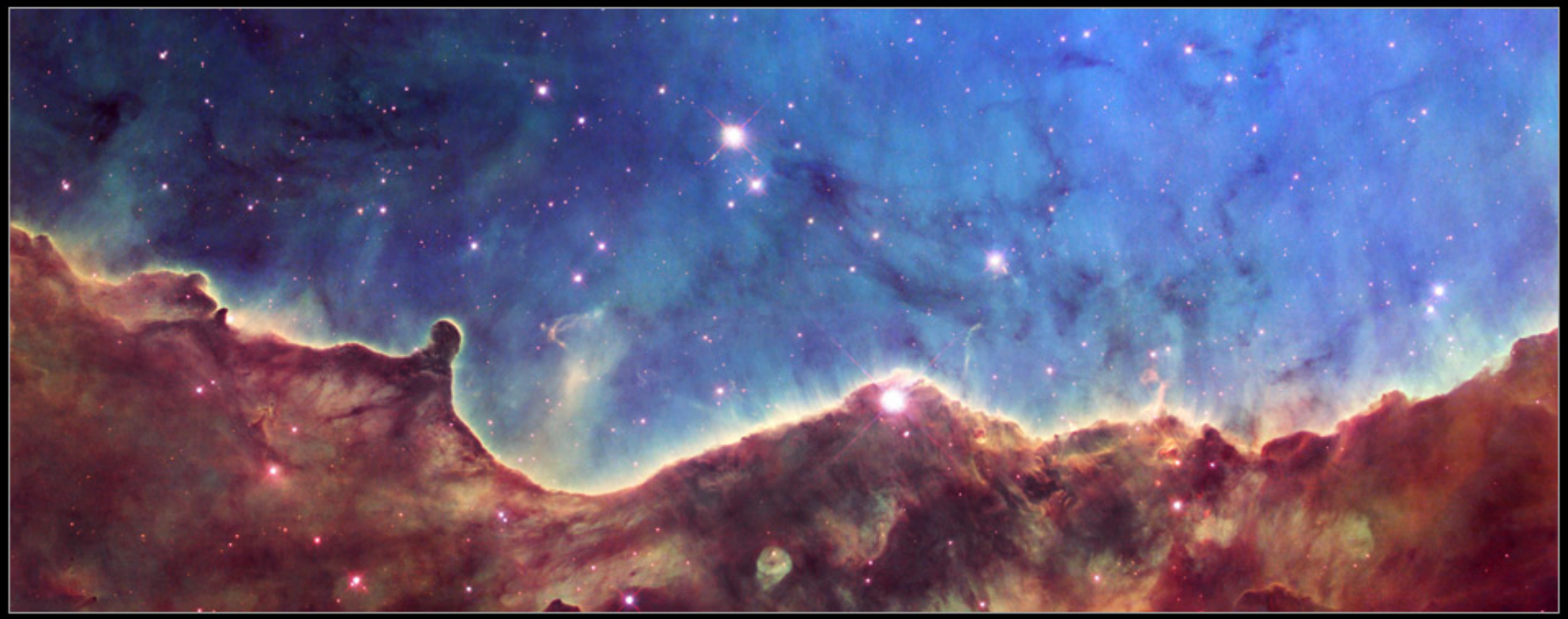
Spiral Galaxy M83

Hubble Heritage

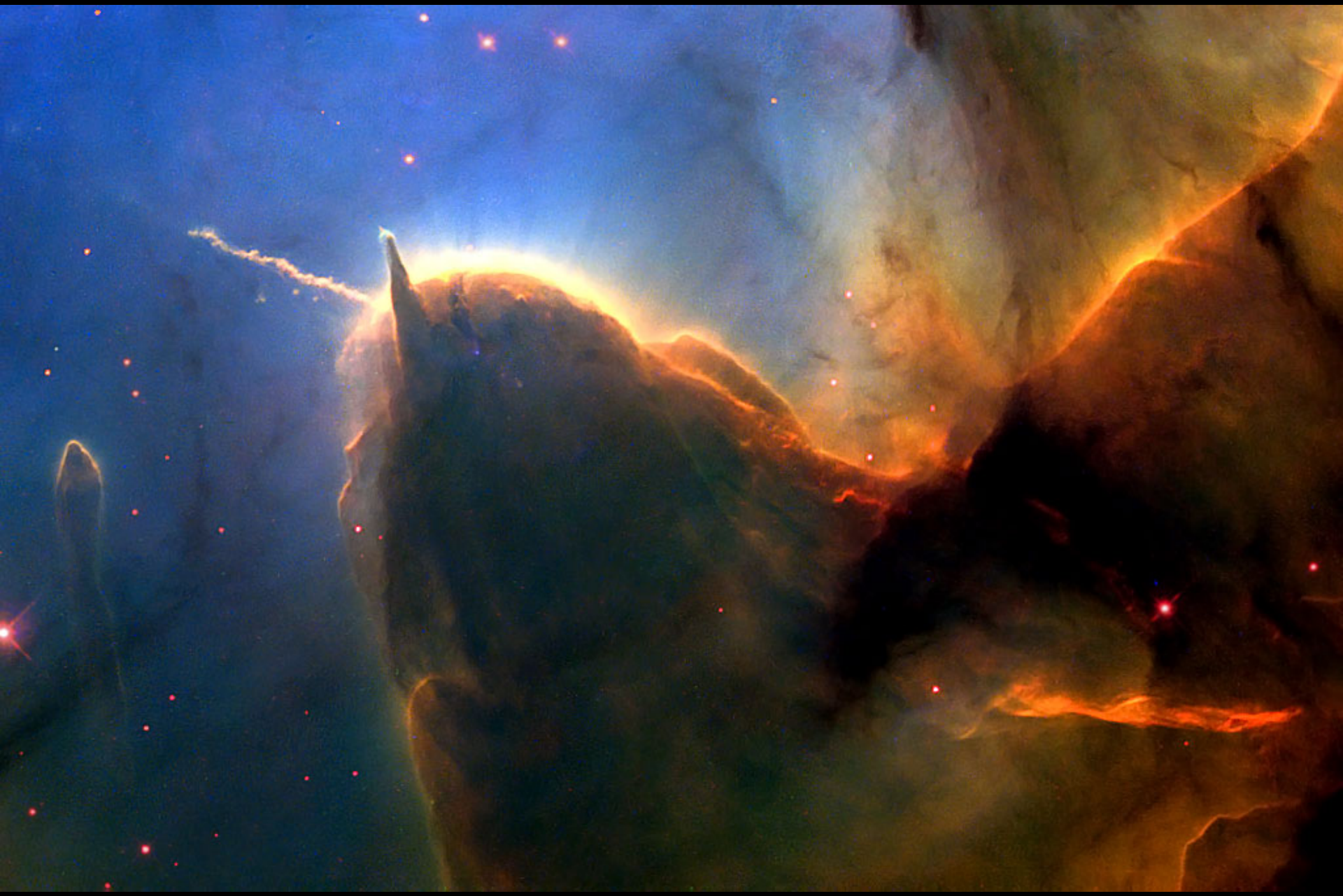
NASA, ESA, R. O'Connell (U. of Virginia), the WFC3 SOC, and the Hubble Heritage Team (STScI/AURA)
HST WFC3 • STScI-PRC09-29

Star-Forming Region NGC 3324



Hubble Heritage

NASA, ESA, and The Hubble Heritage Team (STScI/AURA) • *Hubble Space Telescope* WFPC2 • STScI-PRC08-34

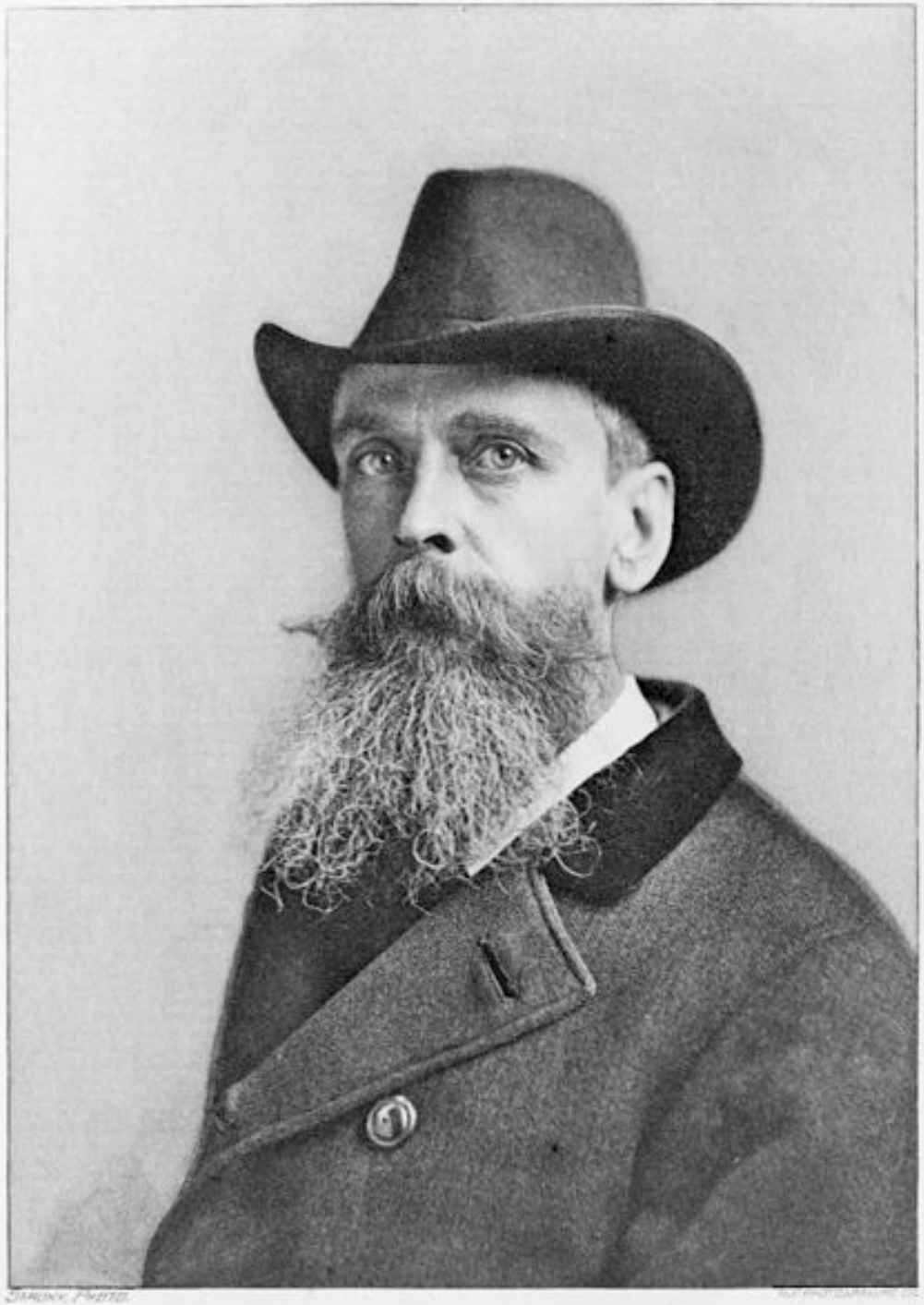



Jet in the Carina Nebula: WFC3 UVIS Full Field
HUBBLESITE.org


3101. MOUNT OF THE HOLY CROSS.

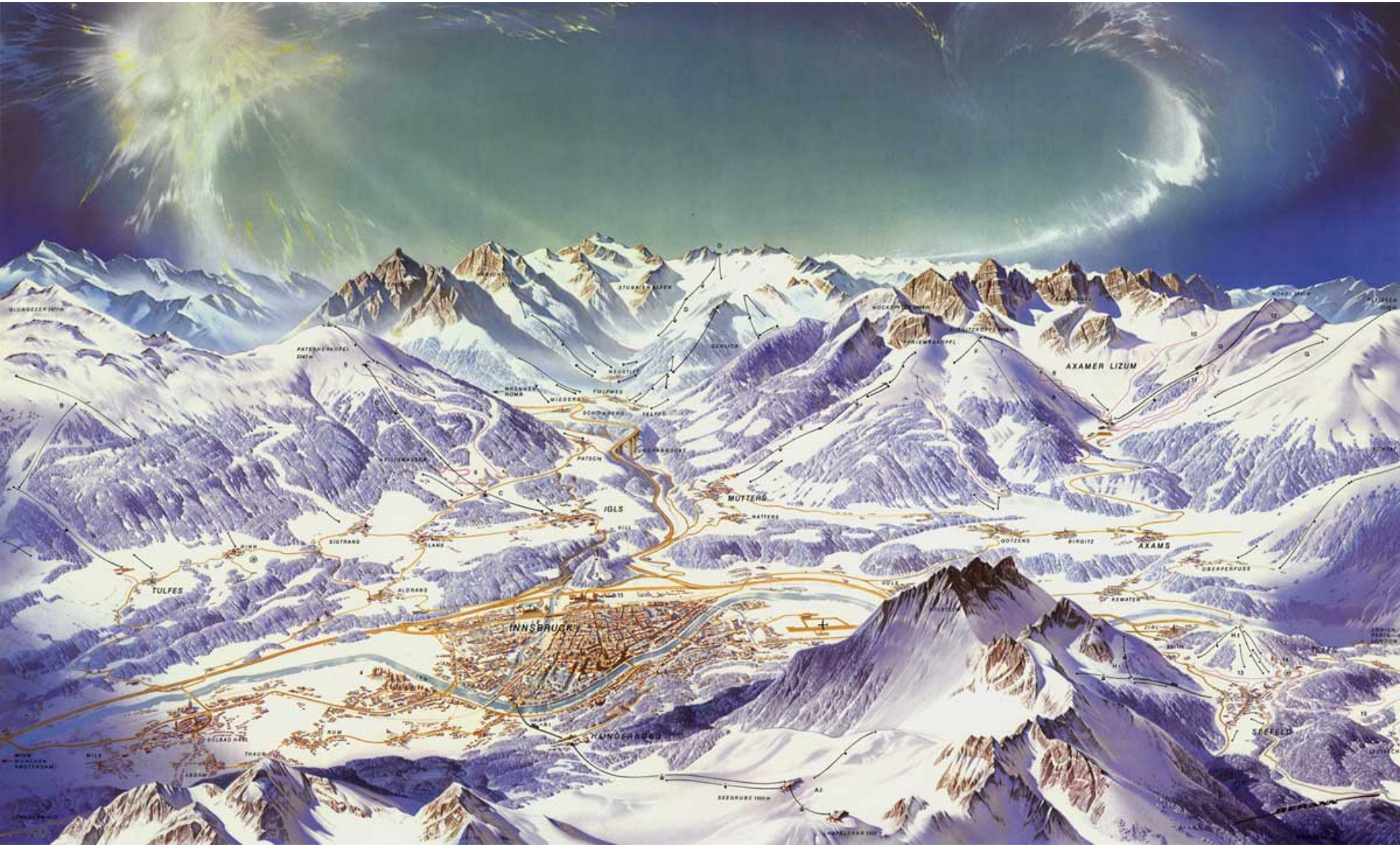
Figure 13. Timothy O'Sullivan, *Inscription Rock, New Mexico,* 1873. O'Sullivan made a stereograph, a common form of visual entertainment in the late nineteenth century, of this rock outcropping.

Figure 14. Timothy O'Sullivan, *South Side of Inscription Rock, New Mexico,* 1873. Views of impressive rock formations are associated with the American West and also evoke ideas of the sublime. Courtesy of the U.S. Geological Survey.



SARONY, PHOTO.


BERANN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AXAMER LIZUM
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IGLS
TULFES
INNSBRUCK
HÄTTING
AXAMS
SEEFELD
SEEGRUBE
HAFLEKAR


GREENLAND
HUDSON BAY
NORTH AMERICA
MONTREAL
ST. LAWRENCE
CHICAGO
BOSTON
NEW YORK
WASHINGTON
ISLAND OF NEWFOUNDLAND
FLEMISH CAP
ICELAND
NEW ORLEANS
MIAMI
BAHAMA ISLANDS
CARIBBEAN SEA
CARACAS
MADEIRA
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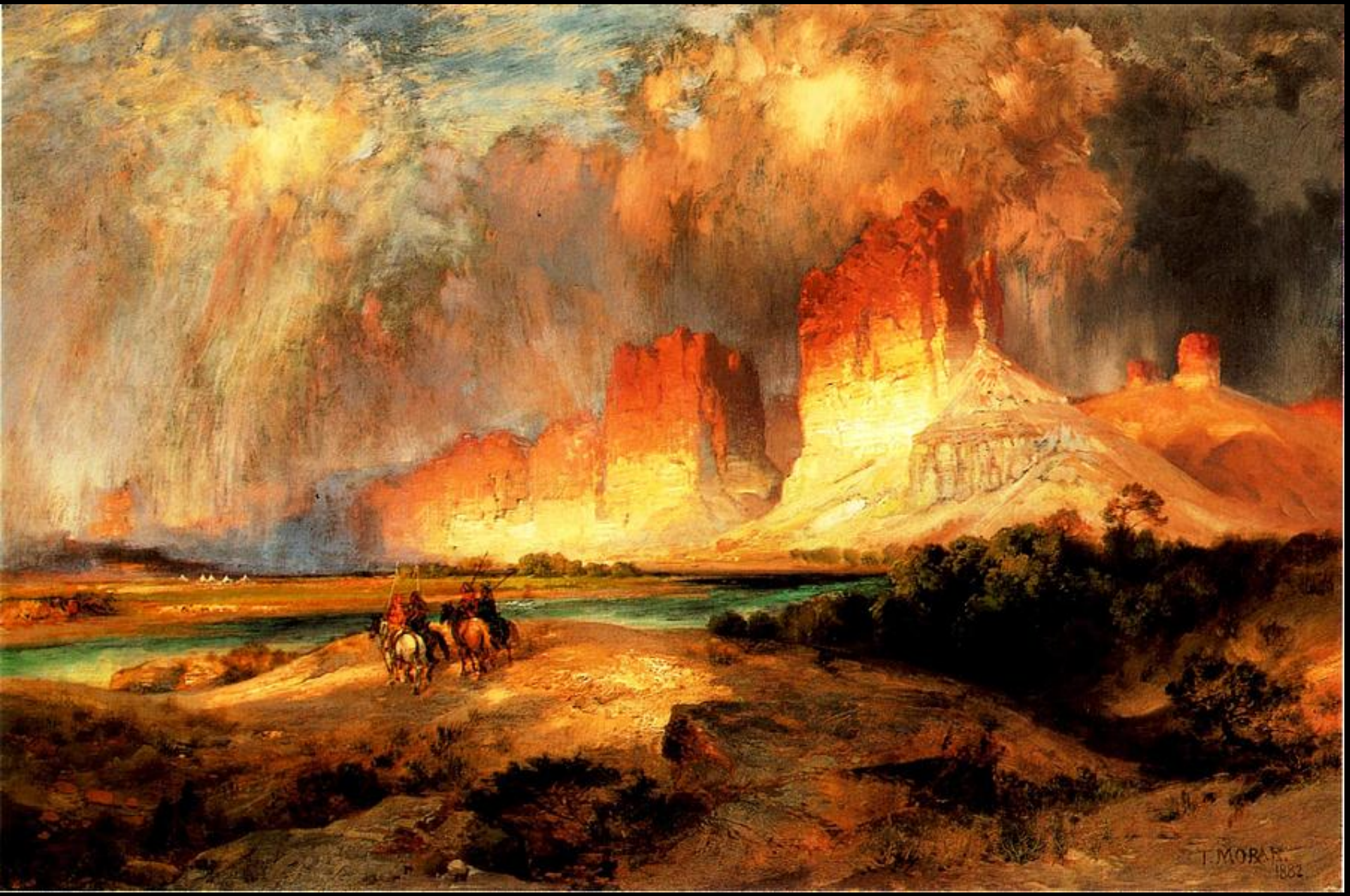
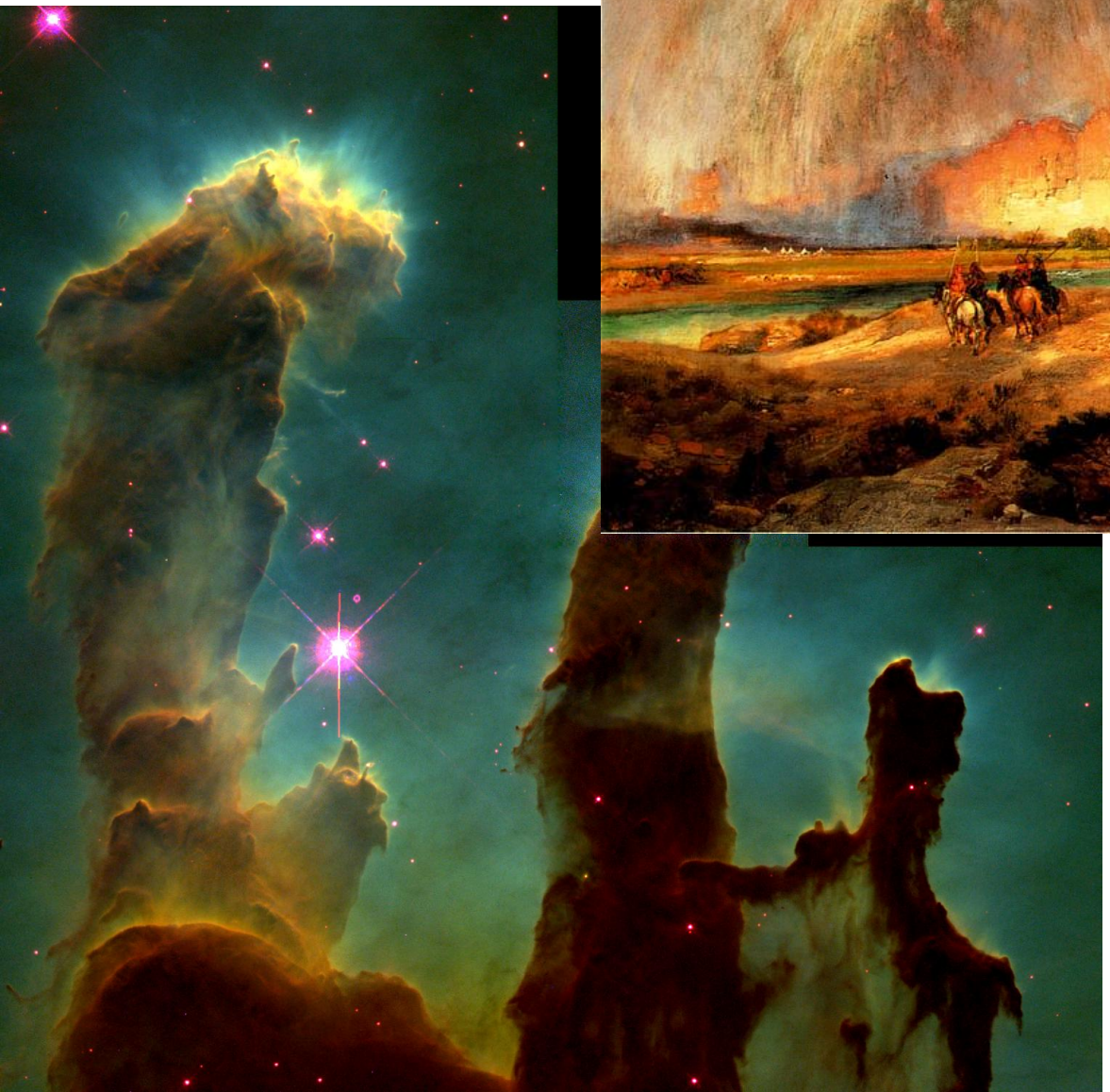
AMAZON CONE
SOUTH AMERICA
AMAZON
FORTALEZA
DAKAR
AFRICA
EQUATOR


T. MORAN
1882

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1882

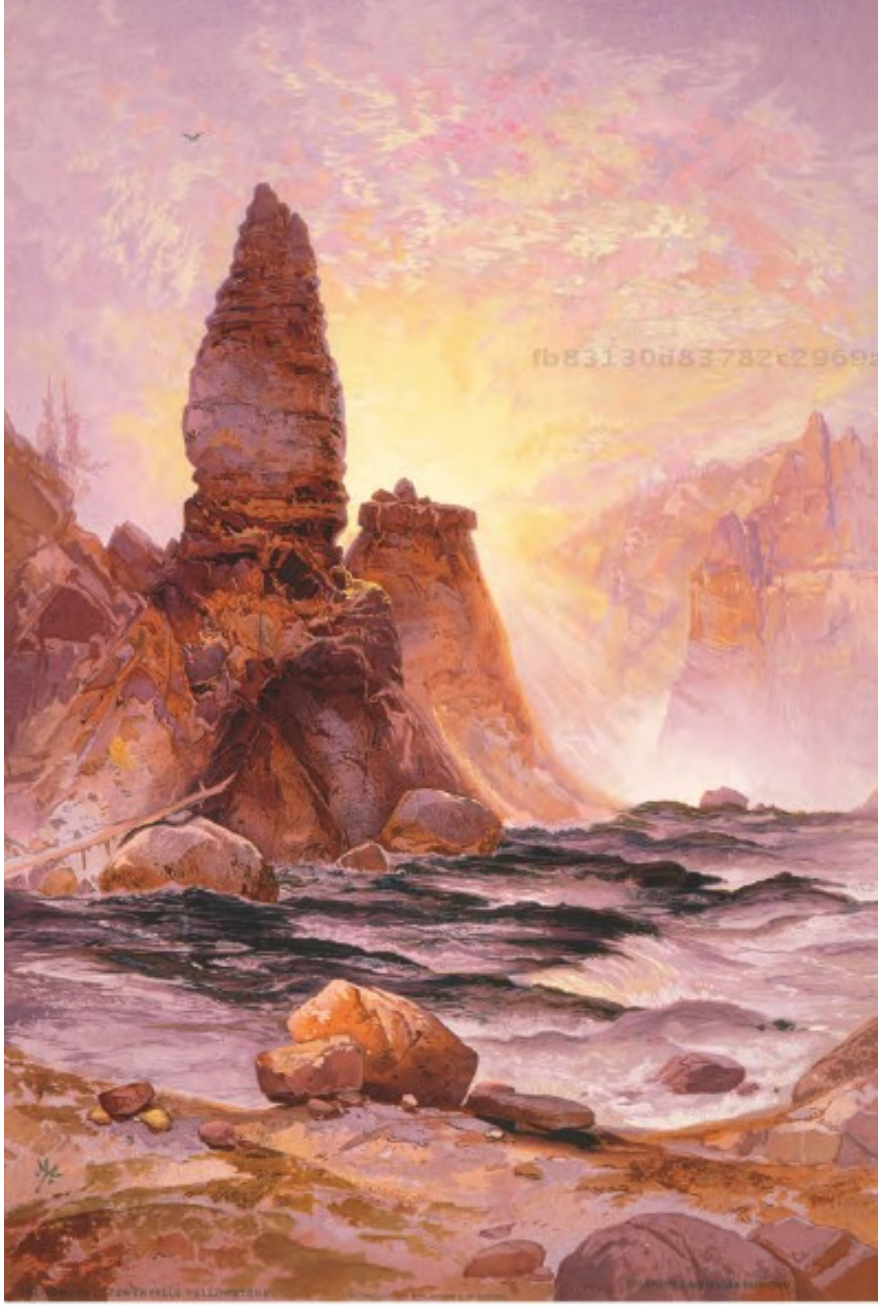
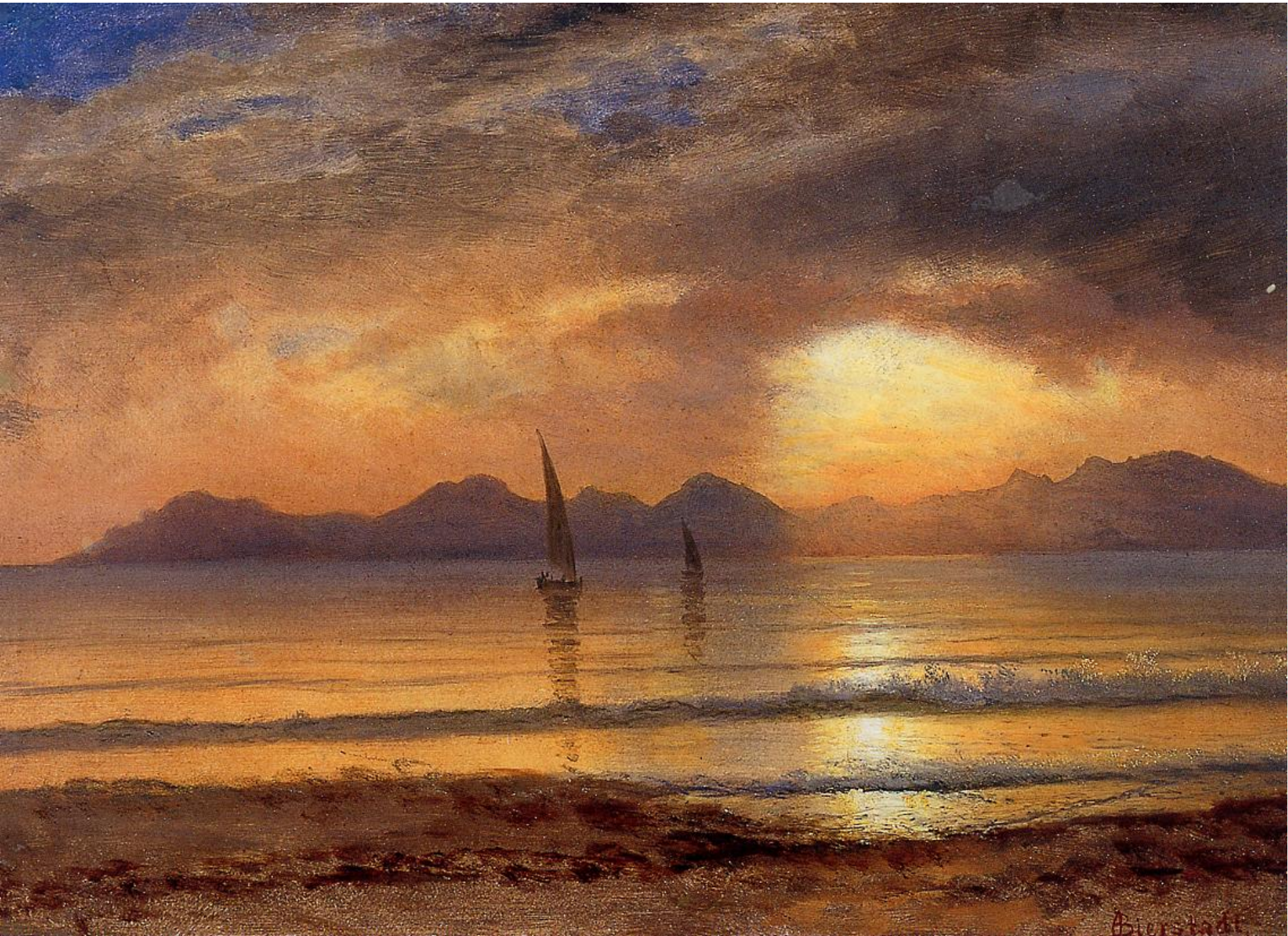


Figure 11. Thomas Moran, *The Tower of Tower Falls,* 1875. Moran created a collection of prints based on his travels through the Yellowstone region. Buffalo Bill Historical Center, Cody, Wyoming; Gift of Clara S. Peck, 18.71.9.

Figure 19. Thomas Moran, *The Chasm of the Colorado*, 1873–74. The vast scale of the Grand Canyon was difficult to represent in a painting, just as it is challenging to frame an immense nebula within a digital image. Smithsonian American Art Museum, Lent by the Department of the Interior Museum.


Bierstadt

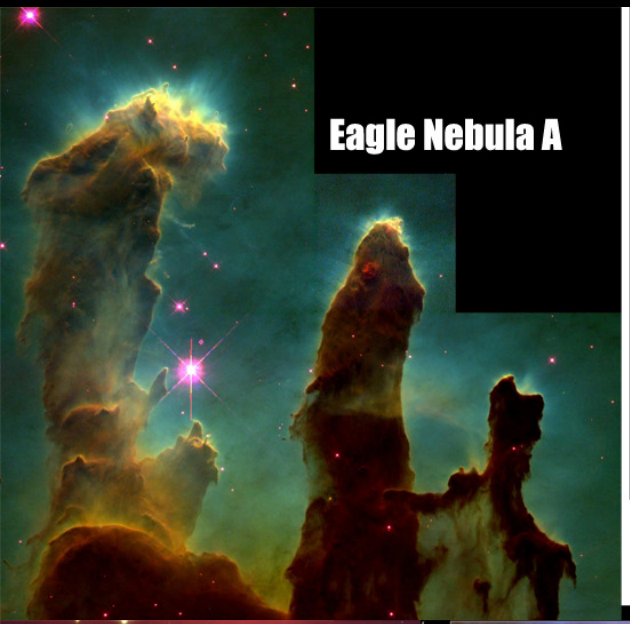


Figure 19. Thomas Moran, *The Chasm of the Colorado*, 1873–74. The vast scale of the Grand Canyon was difficult to represent in a painting, just as it is challenging to frame an immense nebula within a digital image. Smithsonian American Art Museum, Lent by the Department of the Interior Museum.

Figure 16. Albert Bierstadt, *A Storm in the Rocky Mountains, Mt. Rosalie*, 1866. Bierstadt used light and color

Figure 10. Thomas Moran, *Cliffs of the Upper Colorado River, Wyoming Territory*, 1882. The light, color, and composition of many Hubble images recall scenes of the American West. Smithsonian American Art Museum; Bequest of Henry Ward Ranger through the National Academy of Design.

Figure 11. Thomas Moran, *The Tower of Tower Falls*, 1875. Moran created a collection of prints based on his travels through the Yellowstone region. Buffalo Bill Historical Center, Cody, Wyoming; Gift of Clara S. Peck, 18.71.9.

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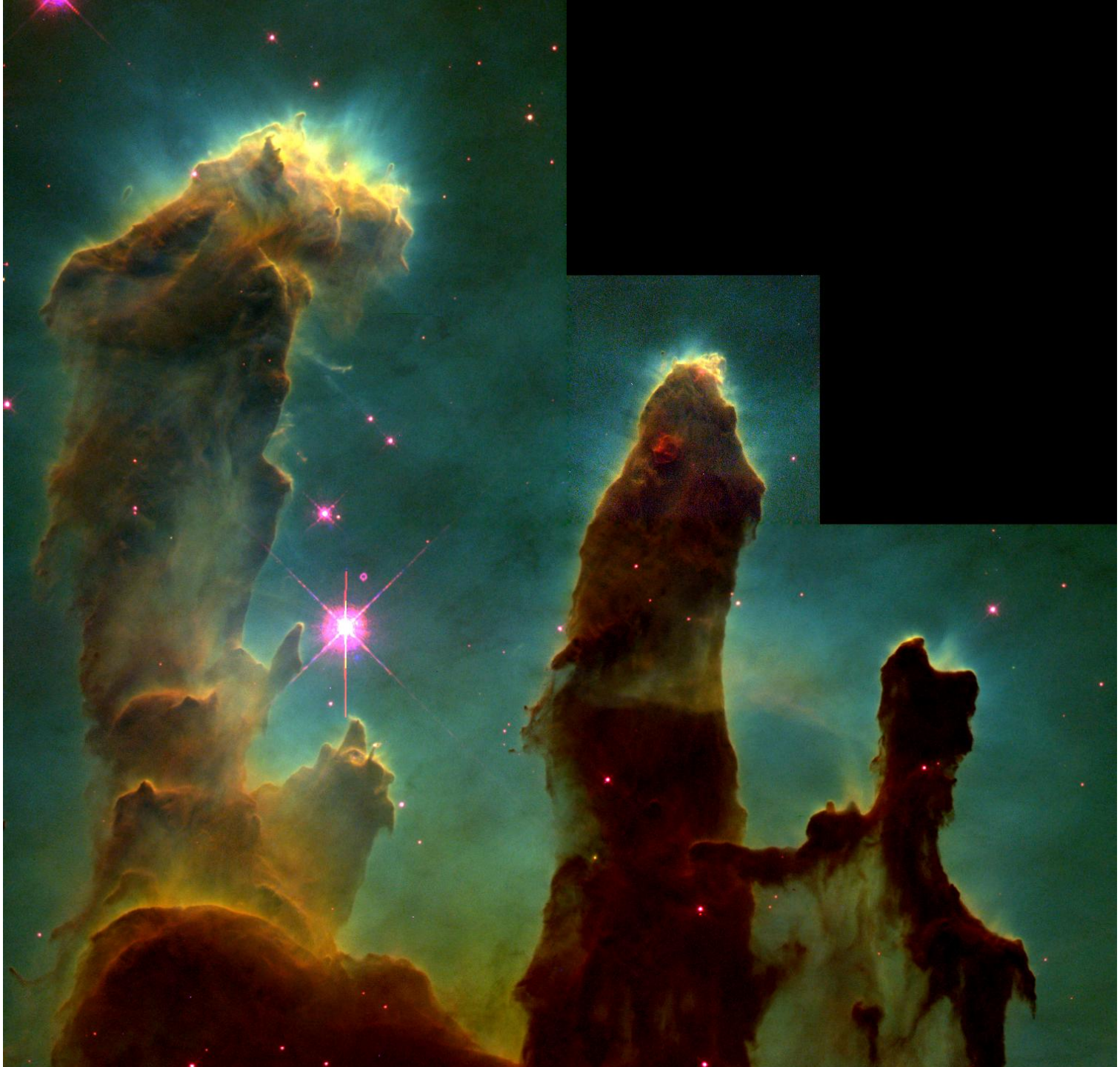
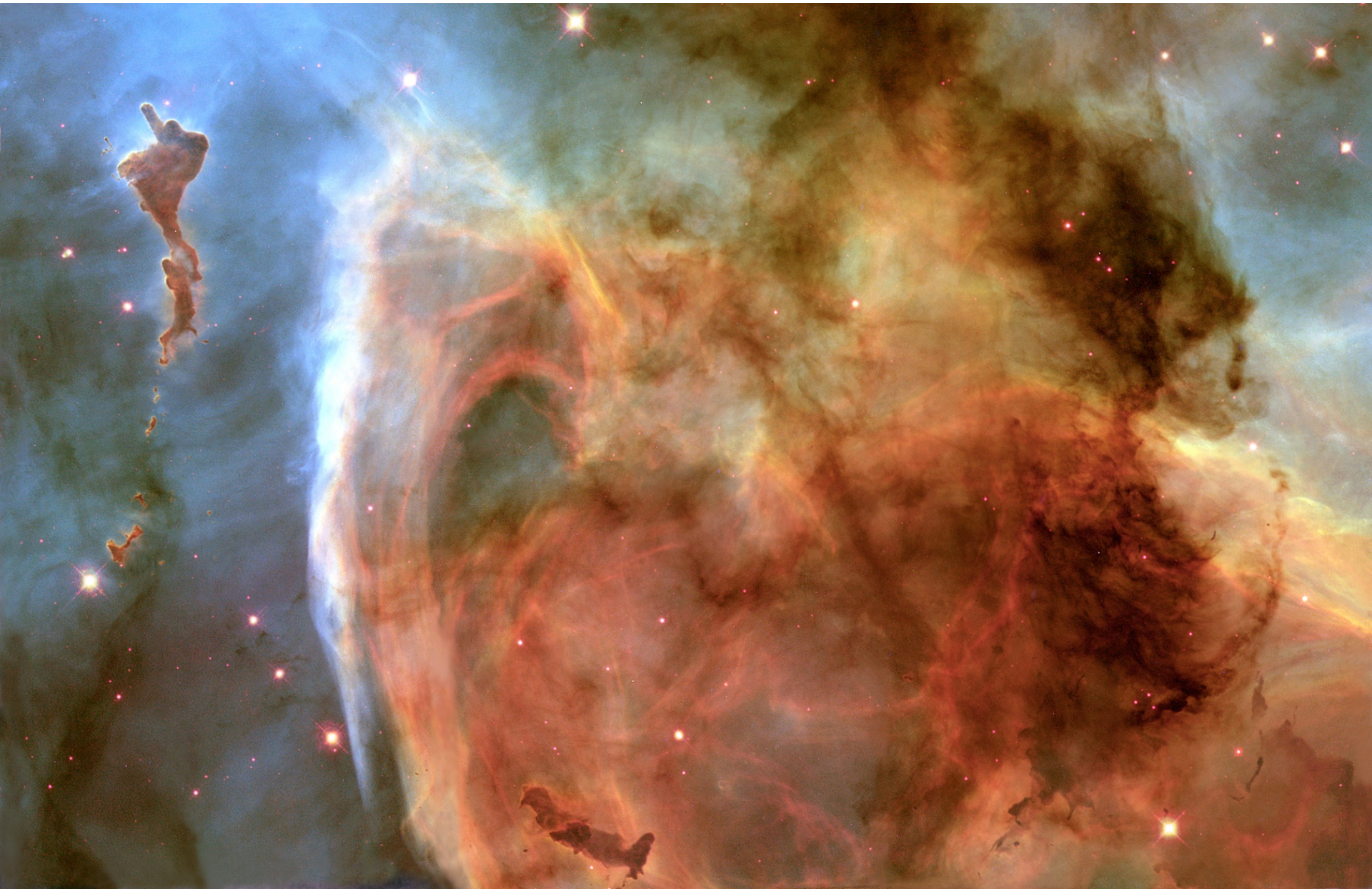


Star-Forming Region NGC 3324

Hubble Heritage




Jet in the Carina Nebula: WFC3 UVIS Full Field
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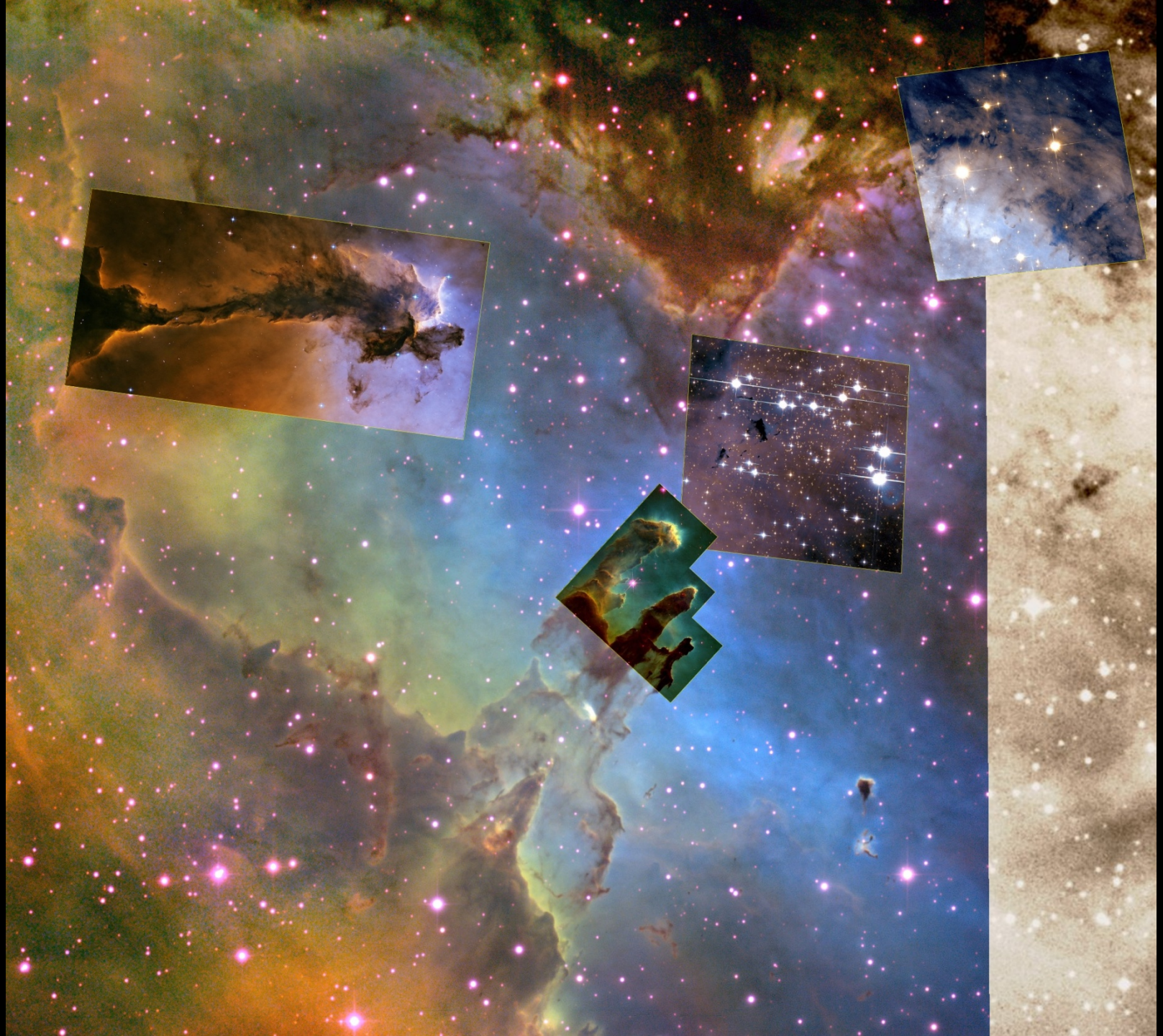
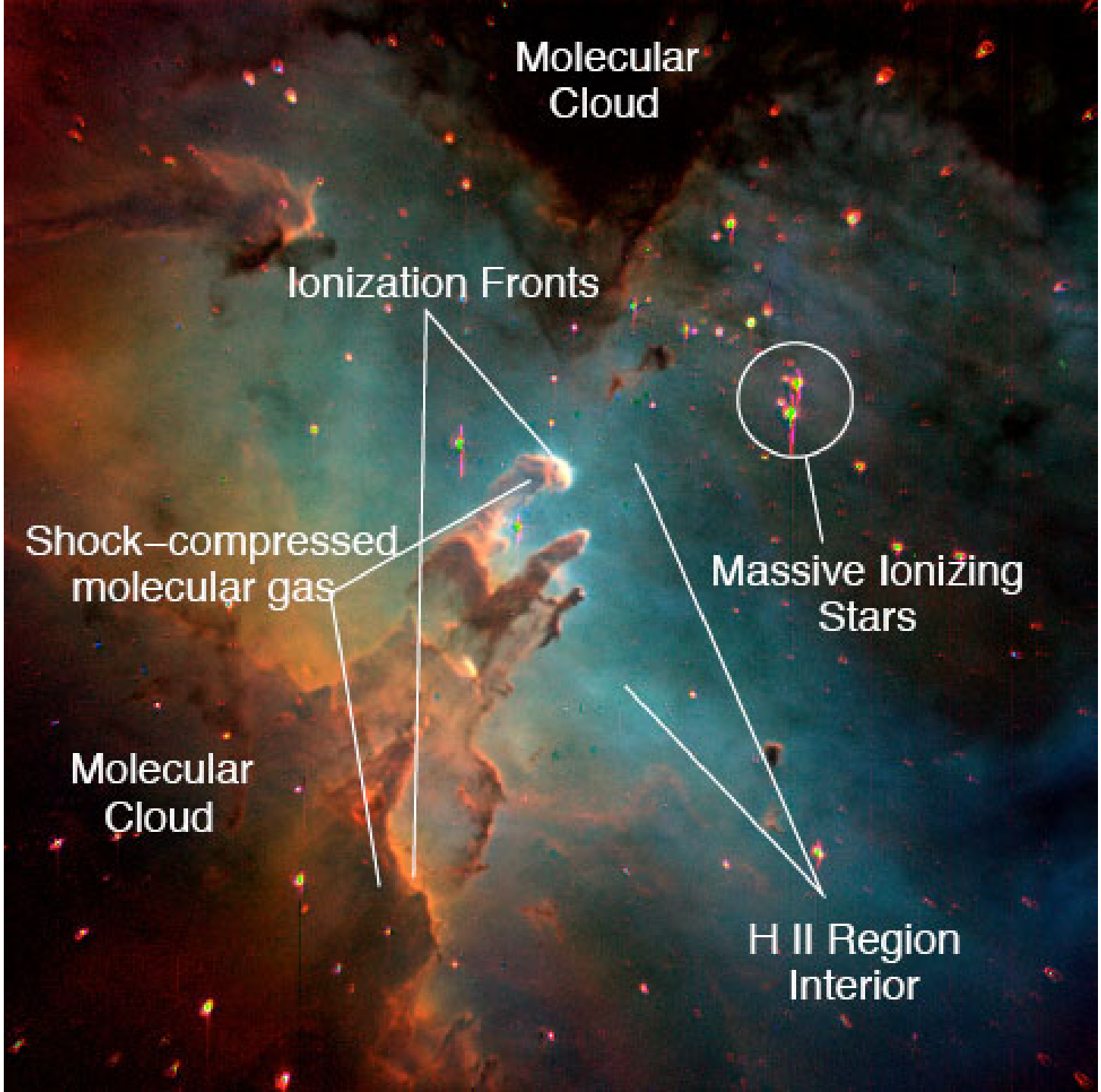


Messier 16 - The Pillars of Creation - HST Palette


Molecular
Cloud
Ionization Fronts
Shock–compressed
molecular gas
Massive Ionizing
Stars
Molecular
Cloud
H II Region
Interior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