

NASA Images in New Expedited Mail Stamps

by John F. Dunn

On January 22—one day after the next round of increases in postage rates goes into effect—the USPS will issue its new Expedited Mail stamps, a \$30.45 Priority Mail Express Cosmic Cliffs stamp and a \$9.85 Priority Mail Pillars of Creation stamp. Note that nowadays the Postal People identify both stamps as “Priority Mail,” adding “Express” for its faster service.

Here’s the gist of the USPS news release for these two stamps:

Pillars of Creation (Priority Mail): Captured by the James Webb Space Telescope, this extremely high-definition infrared image shows the magnificent Pillars of Creation formation within the Eagle Nebula. By assigning color to various wavelengths, the digitized image allows us to see a landscape otherwise invisible to the human eye. Red areas toward the end of the pillars show burgeoning stars ejecting raw materials as they form, while the relatively small red orbs scattered throughout the image show newly born stars.

Cosmic Cliffs (Priority Mail Express): This image from the James Webb Space Telescope is a digitally colored depiction of the invisible bands of mid-infrared light emitted by the Cosmic Cliffs of the Carina Nebula. Red and yellow flares scattered throughout the cliffs show developing and newly born stars. The orange-and-brown clouds in the lower third of the image are swirls of dust and gas. Additional stars, in our Milky Way and in distant galaxies, appear in the blue and black regions above and beyond the nebula.

Greg Breeding, an art director for USPS, designed both stamps using images provided by the National Aeronautics and Space Administration (NASA), the European Space Agency, the Canadian Space Agency and the Space Telescope Science Institute.

For additional background information, I went to NASA’s website, nasa.gov, via Google searches for the two stamp titles. What follows is a portion of the extensive discussions on that site.

The James Webb Space Telescope is the world’s premier space science observatory. Webb will solve mysteries in our solar system, look beyond to distant worlds around other stars, and probe the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and CSA (Canadian Space Agency).

NASA’s Webb Reveals **Cosmic Cliffs**, glittering landscape of star birth. This landscape of “mountains” and “valleys” speckled with glittering stars is actually the edge of a nearby, young, star-forming region called NGC 3324 in the Carina Nebula. Captured in infrared light by NASA’s new James Webb Space Telescope, this image reveals for the first time previously invisible areas of star birth.

Objects in the earliest, rapid phases of star formation are difficult to capture, but Webb’s extreme sensitivity, spatial resolution, and imaging capability can chronicle these elusive events. Called the Cosmic Cliffs, Webb’s seemingly three-dimensional picture looks like craggy mountains on a moonlit evening. In reality, it is the edge of the giant, gaseous cavity within NGC 3324, and the tallest “peaks” in this image are about 7 light-years high. The cavernous area has been carved from the nebula by the intense ultraviolet radiation and stellar winds from extremely massive, hot, young stars located in the center of the bubble, above the area shown in this image.

The blistering, ultraviolet radiation from the young stars is sculpting the nebula’s wall by slowly eroding it away. Dramatic pillars tower above the glowing wall of gas, resisting this radiation. The “steam” that appears to rise from the celestial “mountains” is actually hot, ionized gas and hot dust streaming away from the nebula due to the relentless radiation.

Webb reveals emerging stellar nurseries and individual stars that are completely hidden in visible-light pictures. Because of Webb’s sensitivity to infrared light, it can peer through cosmic dust to see these objects. Protostellar jets, which emerge clearly in this image, shoot out from some of these young stars. The youngest sources appear as red dots in the dark, dusty region of the cloud.

These observations of NGC 3324 will shed light on the process of star formation. Star birth propagates over time, triggered by the expansion of the eroding cavity. As the bright, ionized rim moves into the nebula, it slowly pushes into the gas and dust. If the rim encounters any unstable material, the increased pressure will trigger the material to collapse and form new stars.

Conversely, this type of disturbance may also prevent star formation as the

star-making material is eroded away. This is a very delicate balance between sparking star formation and stopping it. Webb will address some of the great, open questions of modern astrophysics: What determines the number of stars that form in a certain region? Why do stars form with a certain mass?

Webb will also reveal the impact of star formation on the evolution of gigantic clouds of gas and dust. While the effect of massive stars—with their violent winds and high energy—is often apparent, less is known about the influence of the more numerous low-mass stars. As they form, these smaller stars create narrow, opposing jets seen here, which can inject a lot of momentum and energy into the clouds. This reduces the fraction of nebular material that seeds new stars.

Located roughly 7,600 light-years away, NGC 3324 was imaged by Webb’s Near-Infrared Camera (NIRCam) and Mid-Infrared Instrument (MIRI). In MIRI’s view, young stars and their dusty, planet-forming disks shine brightly in the mid-infrared, appearing pink and red. MIRI reveals structures that are embedded in the dust and uncovers the stellar sources of massive jets and outflows. With MIRI, the hot dust, hydrocarbons, and other chemical compounds on the surface of the ridges glow, giving the appearance of jagged rocks.

NGC 3324 was first cataloged by James Dunlop in 1826. Visible from the Southern Hemisphere, it is located at the northwest corner of the Carina Nebula (NGC 3372), which resides in the constellation Carina. The Carina Nebula is home to the Keyhole Nebula and the active, unstable supergiant star called Eta Carinae.

The **Pillars of Creation** are set off in a kaleidoscope of color in NASA’s James Webb Space Telescope’s near-infrared-light view. The pillars look like arches and spires rising out of a desert landscape, but are filled with semi-transparent gas and dust, and ever changing. This is a region where young stars are forming—or have barely burst from their dusty cocoons as they continue to form.

NASA’s James Webb Space Telescope has captured a lush, highly detailed landscape—the iconic Pillars of Creation—where new stars are forming within dense clouds of gas and dust. The three-dimensional pillars look like majestic rock formations, but are far more permeable. These columns are made up of cool interstellar gas and dust that appear—at times—semi-transparent in near-infrared light.

Webb’s new 2014 view of the Pillars of Creation, which were first made famous when imaged by NASA’s Hubble Space Telescope in 1995, will help researchers revamp their models of star formation by identifying far more precise counts of newly formed stars, along with the quantities of gas and dust in the region. Over time, they will begin to build a clearer understanding of how stars form and burst out of these dusty clouds over millions of years. A new, near-infrared-light view helps us peer through more of the dust in this star-forming region. The thick, dusty brown pillars are no longer as opaque and many more red stars that are still forming come into view.

Newly formed stars are the scene-stealers in this image from Webb’s Near-Infrared Camera (NIRCam). These are the bright red orbs [barely visible in the stamp image] that typically have diffraction spikes and lie outside one of the dusty pillars. When knots with sufficient mass form within the pillars of gas and dust, they begin to collapse under their own gravity, slowly heat up, and eventually form new stars.

What about those wavy lines that look like lava at the edges of some pillars? These are ejections from stars that are still forming within the gas and dust. Young stars periodically shoot out supersonic jets that collide with clouds of material, like these thick pillars. This sometimes also results in bow shocks, which can form wavy patterns like a boat does as it moves through water. The crimson glow comes from the energetic hydrogen molecules that result from jets and shocks. This is evident in the pillars—the NIRCam image is practically pulsing with their activity. These young stars are estimated to be only a few hundred thousand years old.

Although it may appear that near-infrared light has allowed Webb to “pierce through” the clouds to reveal great cosmic distances beyond the pillars, there are almost no galaxies in this view. Instead, a mix of translucent gas and dust known as the interstellar medium in the densest part of our Milky Way galaxy’s disk blocks our view to much of the deeper universe. Each advanced instrument offers researchers new details about this region, which is practically overflowing with stars.

This tightly cropped image is set within the vast Eagle Nebula, which lies 6,500 light-years away.

