

History

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RIVERBOAT WORKERS. DRAWN CURTAINS. CLOCK FACES. IN 1848, A SET OF DAGUERREOTYPES CAPTURED A

STUNNINGLY DETAILED PANORAMA OF BUSTLING MIDDLE AMERICA. ZOOM IN AND THE PAST COMES TO LIFE.



| BY JULIE REHMEYER |

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Exposed

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1848, Charles Fontayne and William Porter produced one of the most famous photographs in the history of the medium—a panorama spanning some 2 miles of Cincinnati waterfront. They did it with eight 6.5- by 8.5-inch daguerreotype plates, a then-new technology that in skilled hands displays mind-blowing resolution. ¶ Fontayne and Porter were definitely skilled, but no one knew just how amazing their images were until three years ago, when conservators at George Eastman House in Rochester, New York, began restoration work on the deteriorating plates. Magnifying glasses didn't exhaust their detail; neither did an ultrasharp macro lens. Finally, the conservators deployed a stereo microscope. What they saw astonished them: The details—down to window curtains and wheel spokes—remained crisp even at 30X magnification. The panorama could be blown up to 170 by 20 feet without losing clarity; a digicam would have to record 140,000 megapixels per shot to match that. Under the microscope, the plates revealed a vanished world, the earliest known record of an urbanizing America. ¶ But the conservators also found trouble. At that magnification, dust motes smaller than red blood cells became image-obscuring blobs. Corrosion from a few molecules of water obscured a face peeking out a window. Even polishing marks from the original preparation of the plates became a mass of dark streaks. ¶ Trying to restore the plates themselves might have damaged the images, and the conservators didn't want to risk ruining the finest American daguerreotypes in existence. So they put them in a case filled with inert argon gas to arrest the deterioration and went digital, turning to computer vision specialists at the University of Rochester. To them, the images were just noisy data, which they knew how to scrub. ¶ Now Fontayne and Porter's daguerreotype is stabilized and its details restored—21st-century technology rescued an image from the 19th. The Cincinnati Public Library plans to make a zoomable version available online in the next year.

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Julie Rehmeyer (jrehmeyer@gmail.com) wrote about poker-playing robots in issue 16.12.



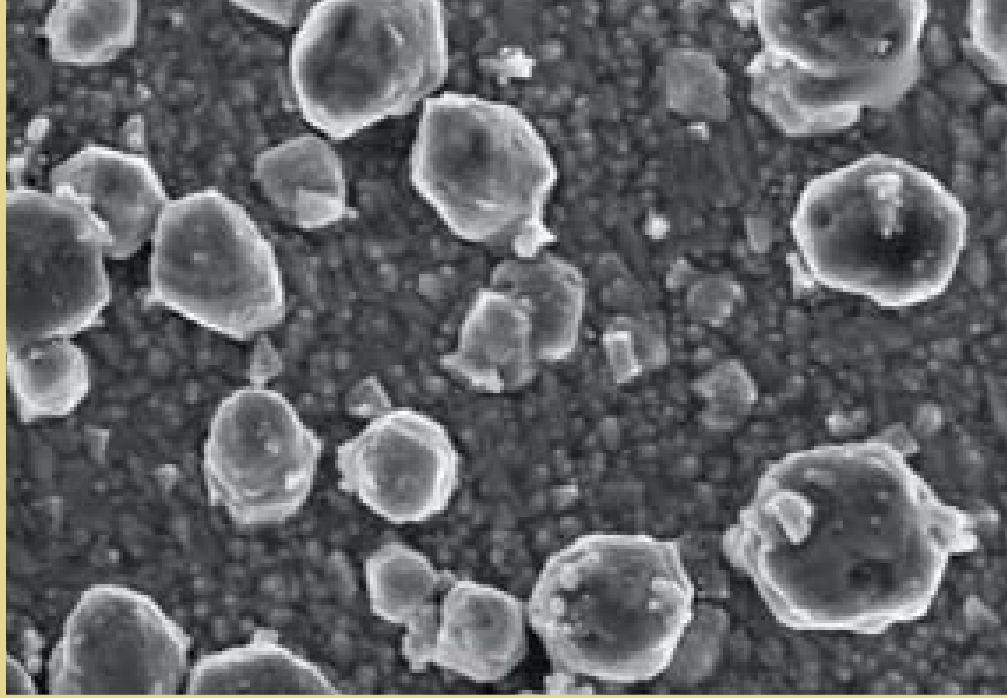
Fontayne and Porter's panorama of Cincinnati, shown below in its entirety, has the resolution of a 140,000-megapixel digital camera.

Daguerreotypes courtesy of the
Public Library of Cincinnati and Hamilton County



1

1 micron



100,000X magnification

HOW THE IMAGES WERE MADE

Daguerreotypes start as copper plates with a thin, mirror-polished coating of silver that's been exposed to halogen gas (iodine or bromine) to make silver halide. Light hitting this compound knocks an electron loose, which attaches to a silver ion, forming a neutral silver atom. The result is that all the places on the plate exposed to light are clusters of pure silver, and the rest is silver halide.

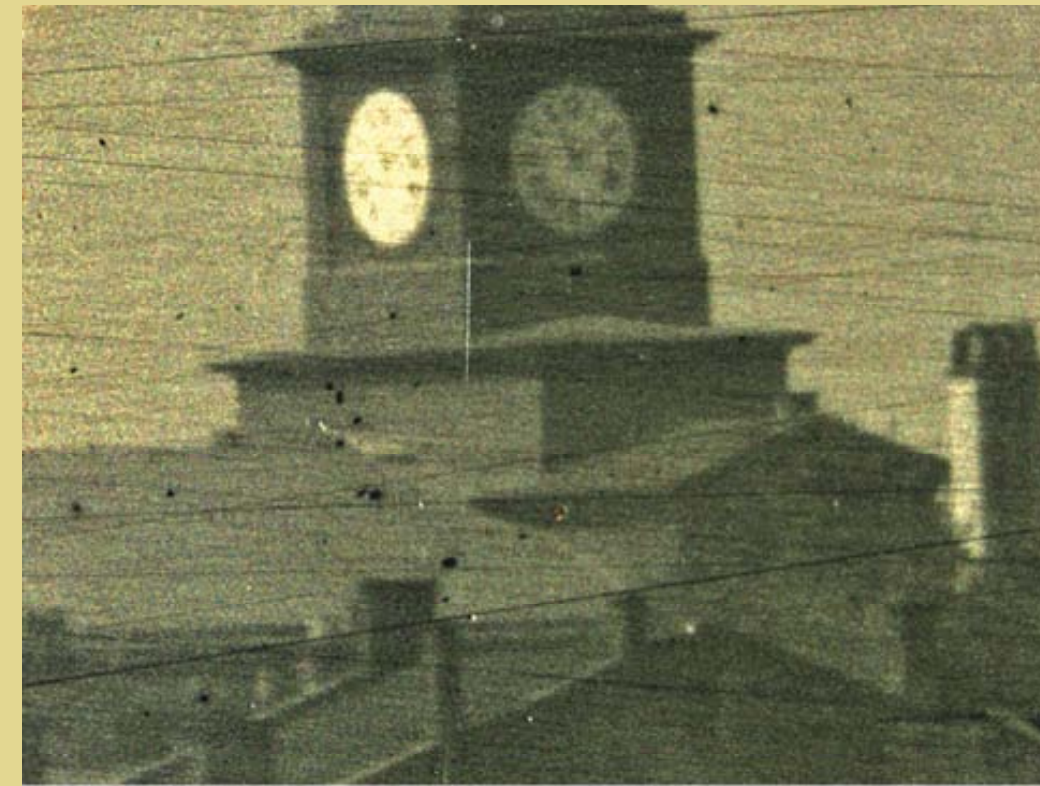
Next, the exposed plate is held over a warm pool of mercury (don't breathe!). The mercury combines with the silver atoms, creating the equivalent of a digital image's pixel: a tiny "grain" between 150 and 800 nanometers in diameter that scatters light, making areas of the surface that were exposed to more light appear brighter. Finally, the plate is soaked in sodium thiosulfate, which washes away the

unexposed silver halide, leaving dark regions—the image's blacks and grays.

The result is a one-of-a-kind direct positive—as opposed to the negative produced by modern chemical photography—with a haunting, soft, almost three-dimensional quality. Look at a daguerreotype from the wrong angle and you'll see only a reflection: The image is trapped inside the mirrored surface.

3

WHAT THE DETAILS REVEALED



As a historical record, the Fontayne-Porter daguerreotype is unparalleled. It contains the first photographic images of steamboats, a railroad station, and one of the country's earliest astronomical observatories. It may also be one of the earliest pictures to show free blacks, who were building a community in Cincinnati, just across the line from Kentucky slave country. A ditch running from the corner of a building down to the river—eroded by effluent from an outhouse—presages the cholera epidemic that hit the city the following year.

Even artifacts of daguerreotype preparation yielded new knowledge. The silver surface of an unexposed daguerreotype is tricky to polish to a mirror finish—even the finest cloths or brushes leave tracks that are clearly visible at high magnification. But the art historians didn't want those marks removed; they wanted to be able to enhance them. It turns out that the streaks act as signatures. Each daguerreotypist had a distinct method of polishing—sweeping tiny suspended brushes across the plate or hand-polishing (as Fontayne and Porter did) with carefully

chosen cloths. The resulting patterns vary, but in a small region they all look like very fine, roughly parallel dark lines. So Messing, Ardis, Tang, and their collaborators designed an algorithm to detect these unique patterns and bleach out the rest of the image.

After all the restoration, historians now know the exact hour and minute when the image was captured. Back in 1947, steamboat enthusiast Frederick Way and Cincinnati Public Library director Carl Vitz undertook an extensive historical investigation of the daguerreotype, using

steamboat records to identify the only date on which all of those vessels were in Cincinnati: September 24, 1848. And by analyzing the angles of shadows, they figured the shots must have been taken just before 2 p.m. A clock tower showed the time, but however much the researchers strained to read the 1-millimeter-diameter clock face with a magnifying glass, they couldn't make it out.

When the images emerged from Eastman House's microscope scanner, the team cheered when they saw the clock tower: It read 1:55.

1 2 3

Specialized software identifies bright white dust spots (1), marks them for repair (2), then restores those pixels (3).



2

HOW THE DAMAGE WAS REPAIRED

The surface of a daguerreotype is so finely textured that dust can adhere to it and become impossible to remove without damaging the image. And even the tiniest particles, which at 30X to 100X magnification show up as bright white spots, can sometimes cause the surrounding areas to tarnish.

That's where the computer vision specialists came in. A team led by Ross Messing, Paul Ardis, and Xiaoqing Tang found that in the Cincinnati daguerreotype, about one pixel in 500 was obscured by dust. And with the series totaling nearly 9 billion pixels, identifying and repairing all the problem areas by hand was obviously out of the question.

Instead, they marked all the dust specks in one small patch and then used machine-learning techniques to train a computer to detect others automatically. The computers searched for other regions in the image similar to the surroundings of the missing pixels and then performed simple copy-and-paste operations to fill in the holes.

1 & 2: PATRICK RAVINES, RALPH WIEGANDT;
3: ROSS MESSING, XIAOQING TANG, PAUL ARDIS

Close-ups of plate 2: Below, city life in 1840s America. In the original image, the clock face above is just 1 millimeter across.



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