c/o ST-ECF
ESO, Karl-Schwarzschild-Str.2
D-85748 Garching bei München,
Germany
Telephone: +49 (0)89 3200 6306
Cellular : +49 (0)173 38 72 621
Telefax: +49 (0)89 3200 6480
hubble@eso.org
www.spacetelescope.org

Hubblecast Episode 21: From silver to silicon **FOR IMMEDIATE RELEASE 9:00 (CET)/04:00 PM EDT 03 November, 2008**		
00:00 **[Visual starts]** **00:12** **[Intro]** **00:18** **[Woman]** This is the Hubblecast! News and images from the NASA/ESA Hubble Space Telescope. Travelling through time and space with our host Doctor J a.k.a. Dr. Joe Liske. **00:29** **[Dr. J]** Hello, and welcome to this fourth, special issue of the Hubblecast, celebrating the International Year of Astronomy in 2009. In the last episode, we saw how the advance of technology through the 1970s and '80s, revolutionised astronomy. Today, we'll discuss how astronomers detected and measured light over the years, from hand-drawings to electronic detectors. **00:52** **[Dr. J]** 400 years ago, when Galileo Galilei wanted to show others what he saw through his telescope, he had to make drawings. The pockmarked face of the Moon. The dance of the Jovian satellites. Sunspots. Or the stars in Orion. He took his drawings and published them in a small book, *The Starry Messenger*. That was the only way he could share his discoveries with others. For well over two centuries, astronomers also had to be artists. Peering through their eyepieces, they made detailed drawings		Intro graphics Hubblecast logo Episode 21: From silver to silicon Dr. J in virtual studio Dr. J slate Dr. J inside virtual castle, sitting on a large chair and with an open book Sketches of Moon, Jovian system, sunspots, Orion Graphic of *The Starry Messenger* Antiquated

of what they saw.		astronomer
The stark landscape of the Moon. A storm in the atmosphere of Jupiter. The subtle veil of gas in a distant nebula.		Sketches of the Moon, Jupiter, and a nebula
And sometimes they over-interpreted what they saw. Dark linear features on the surface of Mars were thought to be canals suggesting civilised life on the surface of the red planet.		Sketches of canals
We now know that the canals were an optical illusion. What astronomers really needed was an objective way to record the light collected by the telescopes without the information first having to pass through their brains and their drawing pens. Photography came to the rescue.		CG footage flying over the Martian surface
02:06 **[Dr. J]** The first daguerreotype of the Moon. It was made in 1840 by Henry Draper. Photography was less than 15 years old, but astronomers had already seized on its revolutionary possibilities.		Dr. J in new digital studio, boasting a large TV screen Image of Moon
So how did photography work? Well the sensitive emulsion of a photographic plate contained small grains of silver halide. Expose them to light, and they turn dark. So the result was a negative image of the sky, with dark stars on a light background.		Representation of photographic process Negative image of galaxy
But the real bonus was that a photographic plate can be exposed for hours on end.		Animation of the night sky, with more stars becoming visible with time
When you take in the night sky with your own eyes, once they're dark adapted, you don't see more and more stars just by looking longer.		
But with a photographic plate you can do just that. You can collect and add up the light over hours on end. So a longer exposure reveals more and more stars.		
And more. And more. And then some.		
In the 1950s, the Schmidt telescope at the Palomar Observatory was used to photograph the entire northern sky.		Time-lapse footage of telescope
Almost 2000 photographic plates, each exposed for nearly an hour. A treasure trove of discovery.		Background images of astronomical objects
Photography had turned observational astronomy into a true science. Objective, measurable, and reproducible. But silver was slow. You had to be patient.		
03:34 **[Narrator]** The digital revolution changed all that. Silicon replaced silver. Pixels replaced grains.		CCD chip Zoom into chip
Even in consumer cameras, we no longer use photographic film. Instead, images are recorded on a light-sensitive chip: a charge coupled device, or CCD for short.		Consumer CCD
Professional CCDs are extremely efficient. And to make them		Professional CCD

even more sensitive, they are cooled down to well below freezing, using liquid nitrogen. Almost every photon is registered. As a result, exposure times can be much shorter. What the Palomar Observatory Sky Survey achieved in an hour, a CCD can now do in a few short minutes. Using a smaller telescope. The silicon revolution is far from over. Astronomers have built huge CCD cameras with hundreds of millions of pixels. And there's more to come. **04:35** **[Dr. J]** The big advantage of digital images is that they're, well, digital. They're all set and ready to be worked on with computers. Astronomers use specialised software to process their observations of the sky. Stretching, or contrast enhancing, reveals the faintest features of nebulae or galaxies. Colour coding enhances and brings out the structures that would otherwise be difficult to see. Moreover, by combining multiple images of the same object that were taken through different colour filters, one can produce spectacular composites that blur the boundary between science and art. You too can benefit from digital astronomy. It has never been so easy to dig up and enjoy the amazing images of the cosmos. Pictures of the Universe are always just a mouse click away! **05:27** **[Narrator]** Robotic telescopes, equipped with sensitive electronic detectors are keeping watch over the sky, right now. The Sloan telescope in New Mexico has photographed and catalogued over a hundred million celestial objects, measured distances to a million galaxies, and discovered a hundred thousand new quasars. But one survey is not enough. The Universe is an ever-changing place. Icy comets come and go, leaving scattered debris in their wake. Asteroids zip by. Distant planets orbit their mother stars, temporarily blocking part of the star's light.		Animation of CCD collecting photons Nebula Telescope montage Dr. J in front of CG binary code Video of image editing Fisheye timelapse of observatory Zoom out from galaxies Comet Asteroid Extrasolar planet transit animation

Supernovas explode, while elsewhere new stars are born. Pulsars flash, gamma-ray bursts detonate, black holes accrete. To keep track of these grand plays of Nature, astronomers want to carry out all-sky surveys every year. Or every month. Or twice a week. At least that’s the ambitious goal of the Large Synoptic Survey Telescope. If completed in 2015, its three-gigapixel camera will open up a webcam window on the Universe. More than fulfilling astronomers’ dreams, this reflecting telescope will photograph almost the entire sky every three nights. **07:01** **[Dr. J]** Thank you for joining me in this fourth episode of the special series. Next time, we’ll see how telescopes can study the Universe we can’t see with our own eyes. This is Dr. J, signing off for the HubbleCast. Once again, nature has surprised us beyond our wildest imagination. **07:18** **[Outro]** **07:42 END**		Supernova Pulsar Black hole / quasar Panning image of night sky Representation of LSST Dr. J in virtual studio Hubblecast is produced by ESA/Hubble at the European Southern Observatory in Germany. The Hubble mission is a project of international cooperation between NASA and the European Space Agency. Credits