

## THE DIGITAL CAMERA REVOLUTION, PART I

*For our Supremely Satisfying Bathroom Reader, we wrote an article about the history of photography, ending with the introduction of Kodak's Instamatic cameras of the 1960s, which we said "brought photography to the masses."*

*We didn't realize it at the time, but photography was about to undergo a substantial—and revolutionary—change: the move to digital.*

### A DEVELOPING STORY

Throughout photography's nearly 200-year history, camera makers have striven to make their products smaller, the images sharper, and the process faster and easier. Yet the advancements of the first century and a half took place at intervals of 5, 10, or even 20 years. Once the digital revolution got going in the 1990s, major advancements started taking place yearly. But it took a few decades of tinkering to get to that point.

The process of creating an electronic camera that could take pictures without film began in 1957 when Russell Kirsch, a computer engineer at the U.S. National Bureau of Standards, created the first scanned image that could be viewed on a TV screen. The grainy black-and-white image—named by *Life* magazine "one of the 100 photographs that changed the world"—was simply a photo of his three-month-old son. Kirsch had invented the scanner but, more importantly, he'd also invented the *pixel* (short for "picture element," and defined as "the smallest unit of an image displayed on a computer or television screen"). Kirsch's baby picture—just 176 pixels wide—marked the beginnings of home computing, satellite imaging, and digital photography.

### SENSOR SHIP

In the 1960s, NASA scientists experimented with the new digital technology in order to, among other things, send images from space probes orbiting the moon back to Earth. In 1961 Eugene Lally, a scientist at the Jet Propulsion Laboratory, published the first description of what he called a *mosaic photosensor*,

It's not widely publicized, but Mr. Clean has a first name: "Veritably."

a device that would translate light into bits of information. Although the technology for Lally's idea didn't yet exist, it got other scientists in the field excited about digital imaging. Willard Boyle and George Smith, two developers at Bell Labs, added the next big piece of the puzzle in 1969: the *charged coupling device*. In simple terms, the CCD is a type of semiconductor that generates an electrical charge when hit by light. This would be the basis for the "sensor" that would later replace the film in digital cameras.

#### THE KODAK DIGITAL TOASTER

This new technology caught the attention of electronics companies such as Texas Instruments (TI) and Eastman Kodak. TI applied for a patent for a digital camera in 1972, but never actually built one. Three years later, in 1975, Kodak bosses charged a 25-year-old engineer named Steven Sasson with a task: Build a camera that utilizes a CCD. "I'd never built a regular camera. What made me think I could build anything with this CCD device?" recalled Sasson. "I decided to take a digital approach because my background was digital and I could avoid the mechanical complexities." He raided other departments for parts he needed, including an analog-to-digital converter adapted from Motorola components and a discarded movie camera lens. After a few months of experimenting, Sasson emerged with a contraption that resembled a big toaster with a lens on one side. It weighed eight pounds and took 23 seconds to produce its first picture: a 0.01 megapixel image of Sasson's lab assistant. The dark, blurry image could be displayed only on a specially made television screen, but it was the first truly digital photograph.

Sasson's superiors were impressed with the accomplishment (though less so with the poor image quality). They asked him how long he thought it would take for the digital camera market to take off. Sasson's answer: "About 15 or 20 years." Kodak patented the invention, but kept their focus on film cameras.

#### GOING COMMERCIAL

The first consumer electronic camera that required no film was the Sony Mavica (short for **M**agnetic **V**ideo **C**amera). Released in 1981, it wasn't a true digital camera, it was a video camera that

King James IV of Scotland was an amateur dentist. He paid people...

could freeze single frames and then transfer them onto a two-inch floppy disk. Just as with Sasson's digital camera, the pictures could be viewed only on a TV screen. The Mavica generated some interest among technology buffs, but at the time few people outside the industry paid much attention to a camera that didn't use film. As the 1980s unfolded, however, the desktop computer was starting to become a fixture in people's homes, and with it came the first widespread interest in a truly digital camera that *anyone* could use.

Kodak played a big part in this. In 1986 they developed a powerful new CCD that worked in *megapixels*. Whereas Sasson's digital toaster could display only 10,000 pixels, it was now possible to create a sensor that could display more than *a million* pixels of information, or one megapixel. (Today's cameras go up to about 15 megapixels...and counting.) After that, the innovations kept coming and coming—from the first photo CDs in 1990 to the first digital camera designed for professional photojournalists in 1991, a Nikon F3 that utilized a 1.3 megapixel sensor built by Kodak. Retail price: \$13,000.

#### TAKING OVER

But the high cost wasn't the only reason that the digital camera was still considered a novelty in the early 1990s. It still couldn't come close to matching the image quality attained by conventional film cameras, which were still much less expensive. So the big camera makers—Nikon, Kodak, Canon, Pentax, Olympus, and Minolta—kept pushing film while they worked on increasing the quality of their digital lines. And as the costs began to fall, digital sales started rising—at about the exact time that Sasson had predicted they would back in 1975. “In the late '90s,” he recalled, “I was vacationing with my family and was waiting for the next eruption of Old Faithful in Yellowstone Park. They have you sit around in a semicircle to watch, and I looked around and there were several digital cameras. I remember telling my wife, ‘It's happening. It's really here.’”

*For Part II, advance to page 204.*

...to let him to practice on their teeth.

## THE DIGITAL CAMERA REVOLUTION, PART II

*In Part I (page 91), we saw the rise of digital camera technology. Now watch as it takes over.*

### TEAMING UP

According to tech industry experts, 1995 marked the beginning of the consumer digital photography era. Among other advances, that year saw the introduction of the Kodak DC40—the first digital camera with a *liquid crystal display*, or LCD monitor. This gave photographers an opportunity never before available: to view the image on the back of the camera just seconds after it was taken. A few months later, Microsoft and Kodak formed a partnership to outfit Kinko's copy stores with kiosks that allowed customers to make photo CDs and send images over the Internet, which was still in its infancy. Around the same time, Hewlett-Packard released the first inkjet printers designed to print out images taken on digital cameras.

All of this technology coming together simultaneously highlights an important aspect of the digital camera: It's just one part of greater revolution that involves the Internet, home computing, scanning, and printing. Technological innovations in each field spurred the others to keep up, which helped spur innovations in those fields as well. And by this point, major advances in the cameras themselves were occurring at such a fast pace that new models were outdated shortly after they hit the market.

### IT'S A SNAP

But even through 2000, film cameras were still selling well. Why? Despite the advances, a digital camera *still* couldn't render as sharp an image as a film camera in the same price range. That changed in 2003 when Canon released the Digital Rebel 300D. Not only could the Rebel's CCD technology record an image finally on par with film, it was the first digital SLR (a camera with interchangeable lenses that can be focused manually) to sell for under \$1,000. Digital cameras have outsold film cameras ever since.

Third-largest movie producer in the U.S., after California and New York: Louisiana.

### FROM THE FIELD

The first profession to truly embrace the advantages of digital was photojournalism. No longer did a photographer on a field assignment have to overnight the negatives to the newsroom: Digital images could be sent instantly. In a highly competitive, deadline-driven field, news photographers had no choice if they wanted to be the first to deliver the scoop.

Photojournalism also played a big part in propelling technological innovations that have since been embraced by the rest of the picture-taking world. Roving photographers complained that the bulky battery packs required to power early digital cameras were too heavy to lug around, so in 1994 the Associated Press partnered with Kodak to create the NC2000—a groundbreaking camera that required a much smaller battery pack, could use standard lenses from film cameras, and had the ability to take hundreds of exposures on a single memory card. By the late '90s, only half of professional photojournalists were using digital technology. Just a few years later, nearly all of them were.

### JUMPING SHIP

After most photojournalists made the switch, it took a few years for the pros who shoot products, architecture, fashion, landscapes, wildlife, and weddings to follow suit.

- One of the first big names to go digital was acclaimed *National Geographic* nature photographer Jim Brandenburg, who did so in 2003. “Remember when vinyl records and tapes were up against CDs?” he asked in his defense (many purists thought he’d sold out). “Now you can hardly find a turntable or a tape player. Some people still prefer the sound of analog, and it will be the same with film. I predict that four years from now, you’re going to see one-hour photo shops closing.”
- One of the last high-profile film holdouts was British celebrity photographer Brian Aris. When he shot the Queen’s 80th birthday party in 2006, he admitted that it would most likely be the last major royal event ever captured with traditional film. When asked what he thought about digital, Aris begrudgingly said, “We’ve all got to embrace it.”

There are 200 Starbucks in London, but only 44 in Starbucks’ home city of Seattle.

### GOING, GOING, GONE

Jim Brandenburg's prediction was off by one year: Most one-hour photo shops were gone by 2006. As for the rest of the industry, it was either switch to digital or go out of business. The choice was clear...film had become an endangered species.

- In 2006 Nikon announced that it was going to keep only two film cameras on the market and convert the company's focus to digital.
- In 2008 Polaroid put an end to its line of analog instant film.
- In 2009 Kodak halted production of Kodachrome slide film, ending an era that began in 1936. "It was certainly a difficult decision to retire it, given its rich history," said Mary Jane Hellyar, President of Kodak's Film, Photofinishing and Entertainment Group. "However, the majority of today's photographers have voiced their preference to capture images with newer technology."

### TOPSY-TURVY

In a little over a decade, the entire field of photography was turned upside down: What had been viewed as an interesting novelty—digital—is now the industry standard. And film—which reigned supreme for more than 150 years—has become a novelty product used only by purists and a few fine-art photographers.

However, the digital camera's true impact on society wasn't because the pros switched over—it was because the rest of us did.

*For Part III, turn to page 382.*

\* \* \*

### WHAT'S YOURS IS...

During a Major League Baseball game in 2004, Alex Rodriguez of the Yankees was on second base when his teammate hit a pop fly to the infield. Toronto Blue Jays third baseman Howie Clark ran over to catch the ball, but backed off when he heard someone yell, "Mine!" Who yelled it? Rodriguez, who ran to third base after Clark missed the catch.

How about yours? The average U.S. home now has more television sets than people.

## THE DIGITAL CAMERA REVOLUTION, PART III

*Now we get to see what develops when nearly every person alive is armed with a camera. (Part II is on page 204.)*

### JUST POINT...AND SHOOT!

By the early 2000s, most of the advancements in digital camera technology had been with 35mm SLRs. But these larger cameras and their interchangeable lenses are primarily used by serious hobbyists and professionals. Most people use their cameras for a much simpler reason: taking snapshots.

The first compact digital point-and-shoots were released in the late 1990s, but it wasn't until 2002 that the first models under \$100 became available. In 2003 the first *single-use* digital cameras became available for less than \$20. Similar to disposable film cameras, you just snap away until the camera's built-in memory card is full (anywhere from 25 to 50 shots) and take it back to the store to receive a set of prints along with a CD of your files. Both of these new cameras caused digital sales to skyrocket. Canon, for example, released its first compact digital in 2000; in 2008 the company celebrated the sale of its *100 millionth* compact digital. But even that feat would be dwarfed by another product of the digital era...a product you probably have with you right now.

### PROUD PAPA

While point-and-shoot digitals make it easier than ever to take and share pictures, they still require people to actually have their cameras on hand when the picture-taking moment arrives. Few people take their camera *everywhere* they go, but these days nearly everyone has another item with them—a cell phone. Putting the two together has altered the way we view our world.

The cell phone camera was invented by Philippe Kahn in 1997. Kahn, a software developer, was sitting in a hospital waiting room in Santa Cruz, California, while his wife was preparing to give birth. He wanted to photograph the new arrival and send the pictures to his friends and family...immediately. So he wrote a

Only 4 nations that do not mandate paid maternity leave:...

crude program on his laptop computer and sent an assistant to get a soldering iron. After some tinkering, Khan took pictures of the delivery and then used his cell phone to send them out via e-mail. Needless to say, his friends were amazed to receive pictures of an event that had occurred only moments earlier—and from a *phone*.

After that, it took three years of development before cell phone cameras became available, first in Japan in 2000, and in the U.S. in 2002. Now, nearly every cell phone comes standard with the ability to shoot digital images and even videos. It's projected that by 2011, more than a billion cell phone cameras will have been sold.

#### A WORLD OF PAPAZZI

A camera now sits in nearly every pocket and purse in the developed world. It's turned everyday people into photojournalists—and has had nearly as big an effect at deterring crime as security cameras. "We've been under surveillance under these big black-and-white cameras on buildings and at 7-Eleven stores," said Fred Turner, an assistant professor of communications at Stanford University. But thanks to cell phones, "the candid camera is wielded by individuals now." Cell phone cameras have allowed people to capture incidents that might have otherwise gone unrecorded: the prisoner abuse at Abu Ghraib in Iraq in 2004, Britain's Prince Harry wearing a Nazi uniform at a party in 2005, the shooting spree at Virginia Tech in 2007, and countless other accounts of "citizen paparazzi."

And now, instead of just calling the police on your cell phone after you've been mugged or carjacked, you can send pictures of the perpetrators and their getaway car. A typical example of a crime-fighting cell-phone camera took place in 2009 in Cape Coral, Florida. A woman was walking her dog when she saw a man breaking into a vacant house. She snapped some pictures on her phone and then called 911. The suspect was quickly captured.

But even more than the news-making moments, it's the cell phone camera's ability to capture the everyday moments that has made it so popular; it's even replaced the wallet as the preferred place to keep baby pictures. "Cell phone cameras have had such a massive impact because they're just so convenient," said Philippe Kahn. "There's always a way to capture memories and share them.

...Lesotho, Swaziland, Papua New Guinea, and the U.S.



You go to a restaurant, and there's a birthday and suddenly everyone is getting their camera phones out. It's amazing."

### OVERSATURATION

The cell phone camera phenomenon has become so widespread, in fact, that it's significantly cutting into the sales of regular digital cameras. And for the first time, the sales of point-and-shoots—which have been steadily climbing—may soon be on the decline. "The manufacturers were rewarded with market growth, but once they filled that bucket, there wasn't any other bucket to fill," said Chris Chute, a digital imaging analyst for the research firm International Data Corporation (IDC).

Why the sudden decline? First, because of aggressive marketing, every time a new camera was released with a slightly higher megapixel capacity, the average consumer's camera became outdated—they *had* to have the new one. But cameras' capacity and reliability have both increased so much since 2005 that only cutting-edge professionals need to update every year or so. Result: In 2006 the IDC concluded that "the digital camera market will peak prematurely, missing the opportunity to replace film cameras as the predominant method of taking photos. Instead the market will be made up of a more diverse range of digital devices with photo capturing abilities, such as cell phones and other combination devices." They predict that 2011 will be the first year that digital camera sales will decrease from the previous year.

### EYES OF THE WORLD

But even if there *is* a decline in sales, between cell phones, point-and-shoots, SLRs, and closed-circuit security cameras, there are *a lot* of digital cameras in the world today. How many? It's tough to say, but there are billions—at least one camera for every person in the world. And according to the International Imaging Industry Association, roughly six billion digital pictures are taken each year. That works out to about 190,000 photos taken around the world every second.

So there's no question that this influx has profoundly affected society—the question is how. Turns out that the digital photography revolution has a downside (a few, actually).

*For Part IV, go to page 518.*

No reporters or photographers have ever been allowed inside the Slinky factory.

## THE DIGITAL CAMERA REVOLUTION, PART IV

*Here's a philosophical question: Just because you can make the sky in your image prettier, or remove the wrinkles from under your eyes, does it mean you should? (Part III is on page 382.)*

### THE DIGITAL DARKROOM

**T**A major factor in the digital revolution has been the camera's partnership with the computer, specifically, with graphics editing software. The most popular program: Adobe Photoshop. It was invented in the late 1980s by brothers John and Thomas Knoll. The sons of a photographer, they combined their love of working in their father's darkroom with their love of computers. Ever since Photoshop 1.0 was released in 1990, the program's ability to alter the colors, tone, brightness, and elements in a photo file has advanced right alongside the digital camera's ability to take better images. By the 2000s, it had become obvious that anyone who is serious about taking and selling pictures must master both photography *and* Photoshop. Those who were able to master the latter have found their skills in great demand.

### THE PHOTOSHOP EFFECT

Altering photos of celebrities, athletes, and models for use in magazines and advertising is nothing new; it's been done to some extent for much of photography's existence. But the advent of Photoshop has taken it to a whole new level—the process is much easier than working in a darkroom, cutting and pasting prints together, or airbrushing photos. Today, nearly every one of the millions of magazine and advertising photographs printed each year are first manipulated by a Photoshop artist. They're experts at removing blemishes and making hips curvier, busts bigger, and waists slimmer. In many cases, a Photoshopper will take elements from many different images of a person—the head from one shot, the nose from another, the body from yet another—and combine them all into one picture.

In the eyes of advocacy groups and government health agen-

Skiers get sunburned almost twice as fast on powder as on slushy snow.

cies, this is having a profound effect on our culture's collective self-esteem. In short, Photoshop, they say, is changing society's definition of what is considered "beautiful" into something that cannot exist in real life. The most common sufferers: teenage girls. According to the U.S. Department of Health and Human Services, 70 percent of girls report that images of models in magazines influence their definition of a perfect female body.

The "Photoshop Effect," as it's called, affects young men, too. Being constantly bombarded by "perfect" images of male celebrities, models, and athletes may be a contributing factor in an increase in steroid usage in teenage boys who want to attain the perfect "cut body." Health officials are so concerned about these trends that they've urged lawmakers in the United States, France, and England to force magazines to disclose the extent to which their images have been retouched. Currently, no such laws are on the books.

#### **PRESSED**

On a similar note, digital manipulation can be a quick, easy way to alter journalistic images. Most news organizations around the world—worried that they'll lose the confidence of their readers—have enforced strict no-tolerance policies toward image manipulation. Two examples:

- In 2003 the *Los Angeles Times* printed an image by staff photographer Brian Walski of an American soldier walking through a crowded Iraqi village. It turned out, though, that it was actually *two* images. In one shot, the soldier had the pose Walski wanted, but the civilians' positions didn't work. In another, the civilians were lined up to Walski's liking, but it appeared that the soldier's gun was pointed toward a child. So Walski used Photoshop to combine the soldier from one image with the civilians from the other. When the editors at the *Times* found out, they apologized to their readers and fired Walski.
- In 2006 *Charlotte Observer* photographer Patrick Schneider altered a photo he took of some firefighters silhouetted against the sky, which he changed from dull gray to deep red...and was fired. After further investigation revealed that Schneider had regularly enhanced his backgrounds and rearranged elements before turning his photos in, the North Carolina Press Photographers

The age at which a woman is likely to reach menopause is 85% determined by her genes.

Association rescinded his three previous “Picture of the Year” awards.

Both of the fired photographers argued that they were merely using Photoshop to make a more accurate portrayal of the scene they actually witnessed; they weren’t using it to lie, but to get closer to the truth. The editors who fired them, however, viewed it differently: The journalist’s job is to objectively present what he or she sees, not to create an idealistic version of it. According to John Chapnick, executive vice president of Black Star, America’s oldest photojournalism agency, “The profession as we know it is threatened by technological transformation. It’s under fire from a suspicious public—watchdog bloggers, cable and radio pundits, and other critics who question the profession’s credibility and authority to bring us an accurate picture of the world.”

#### A WHOLE LOT OF NOTHING

Another downside to the digital photography age: the storage and retrieval of images. The negatives, slides, and prints of yesteryear can last for a century or more if properly stored. Digital images are much more fickle—they’re nothing more than electronic bits of information. As Steven Sasson, inventor of the digital camera, recently put it, “Being able to retrieve, find, and organize images is critical. There is no lack of pictures; there’s a lack of being able to find them. It has to be as easy as taking a picture, and that is going to be a challenge.” Sasson, who still works for Kodak, is one of many scientists working on methods to make it easier to organize digital images, make them more secure wherever or however they’re stored, and make it easier to find and retrieve them. In the meantime, billions of digital pictures remain at the mercy of the world’s hard drives, CDs, DVDs, and the Internet. And as the people who bought the first inkjet printers in the mid-1990s are finding out now, their prints are fading fast. But at least they have something tangible. In reality, only a tiny fraction of all of the digital pictures taken will ever get printed.

#### NOW MUSEUM, NOW YOU DON’T

So which digital storage system is the best? Bad news: none of them. “There isn’t any computer-based storage medium that can be considered archival, irrespective of its physical longevity,” said

An *illeist* is someone who refers to himself in the third person.

Darin Stahl, senior research analyst at the Ontario-based Info-Tech Research Group. The problem with backing up your images on a Web site is that there's no guarantee the site won't get hacked, or that the company will stay in business. The problem with using magnetic-based storage media (disks and hard drives that use a magnetically coated surface to store information) is that they're going to last only about 25 years...if the hard drive doesn't break first or the disk doesn't get scratched. The problem with using optical storage (tiny deformations in a disk that are read by a laser beam and transferred to data) is that it's also unstable; if the disk gets scratched, much of that data—your pictures—will be gone.

So if you want your pictures to last beyond your lifetime, you have to keep up with the latest technology, transferring your files over to the next medium before your current hardware becomes obsolete. Industry experts advise people to back up their most important photos in at least two different systems. But the most stable method of all is still the old-fashioned analog one: Make archival prints, which won't fade or deteriorate, and store them in acid-free folders in a dry, dark place.

#### A PICTURE OF TOMORROW

What's on the horizon for digital photography? Plenty. Tech developers are hard at work on coming up with "the next big thing." Already available are 15-megapixel cameras that can take dozens of high-resolution images in less than a second, and point-and-shoots that incorporate "smile recognition technology"—they automatically take a picture when a person smiles.

In the not-too distant future, cameras may finally be able to record a scene as well as the human eye sees it. Don't they do that already? Not really. If you were standing in a room during the daytime and looked out a window, you'd see details inside *and* outside. Due to the limitations of today's cameras, a photo can only show detail in *one* of these two areas, making the other too dark or too light (unless you use a flash). A new technology under development could change all that. *High dynamic range imaging* will make cameras achieve what's called "photo-realism," recording the scene as it's seen through human eyes. Poorly exposed pictures will be a thing of the past.

The volcano under Yellowstone Park is causing it to rise an average of three inches per year.

But tomorrow's cameras will go even beyond what the eye can do—they'll record the ambient temperature, measure distances between objects in the picture, identify people and objects, and photograph full-color images in the dark without the use of flash.

And as these cameras get better, they'll get smaller, even by today's standards—some the size of credit cards, and some resembling pagers (remember those?), that will clip on to your shirt pocket. And when you want to upload your new pictures, new interactive technology will allow you to simply hold your camera a few inches away from your computer, press a button, and the images will automatically be transferred wirelessly. You'll use this same method to print your images as well. And thanks to an emerging technology called *3-D optical data storage*, you'll be able to store your entire photo library—no matter how large—on a single DVD-size disc.

#### FUSION

Looking beyond that, the cameras of the somewhat distant future will look less and less like a traditional camera. One that's in the planning stages will be incorporated into a pair of eyeglasses and respond to voice commands. Looking beyond even that, scientists have proposed a tiny camera that will mount onto the surface of the human eye and link up directly to the brain. So when you're walking in the park of the future and Big Foot emerges from a UFO, you can just "stare and shoot" and then download the image from your brain, sell it to the tabloids...and get rich!

Yet no matter how advanced these futuristic cameras get, they will all incorporate the same basic light-sensor technology utilized in Steven Sasson's toaster-size digital camera from 1975. Until, that is, some young digital whiz comes up with the *next* "next big thing"—perhaps the Kodak Think-and-Shoot Insta-3-D Levitation 3000. ("You think of the picture, we do the rest!")

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"I have made mistakes, but have never made the mistake of claiming I never made one."

—James G. Bennett

Yo, Flipper! Scientists say that bottlenose dolphins call each other by "name" when they whistle.