They Are Watching You—And Everything Else On The Planet

Technology and our increasing demand for security have put us all under surveillance. Is privacy becoming just a memory?

By Robert Draper

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About 10:30 on a Saturday morning in the north London borough of Islington, two men on mopeds race down the shopping corridor of Upper Street. Sheathed in helmets, gloves, and jackets, they look more like manic video game figures than humans. They weave through traffic and around double-decker buses at kamikaze velocity. Motorists flinch at their approach. The bikers pop wheelies and execute speedy figure eights along the busy street. Still, something more purposeful than joyriding would seem to be on their minds.

After three or four minutes, they abruptly turn off Upper and onto a quiet and leafy residential avenue. They hop the curb and cut their engines. Dismounting on the sidewalk, their helmets still on, they fall into a lengthy conversation. Their dialogue is known only to them. But there is something the men themselves likely don't know: About a mile away, from a windowless room, two other men are watching them.

"They're moving," Sal says to Eric.

The two men sit 10 feet apart, behind a long console in Islington's closed-circuit television (CCTV) control room, painted and carpeted in gray, with no adornments. Sal is middle-aged, while Eric is decades younger. Both wear casual office attire. No small talk passes between them. As the two bikers take off, Sal types away at his computer keyboard, prompting Camera 10 to appear on his screen. And there they are again, flying down Upper Street. As they disappear from Sal's view, Eric quickly locates them on Camera 163. With a joystick, he zooms the camera onto the moped pulling up the rear until its license plate is legible.

Sal radios the police station. "We have two suspicious mopeds doing wheelies on Upper Street."

Two closed-circuit television system operators monitor Islington's control room, where they can watch images from the borough's extensive camera network. London's video surveillance helped solve the deadly 2005 terrorist bombings, which killed 52 people. Photograph by Toby Smith

Facing the men is an immense display with 16 screens. It conveys live images from Islington's network of 180 CCTV cameras. By visible evidence, this Saturday morning is a comparatively placid one. Earlier in the week a young man had died after being stabbed in a flat, and from the overpass at Archway Road, darkly referred to as "suicide bridge," another man had jumped to his death. Later today in Finsbury Park, the cameras would spend hours panning across 35,000

festivalgoers in search of pickpockets, drunken brawlers, and other assorted agents of petty mischief.

For the moment, however, the bikers are the only action in Islington. And though Sal and Eric—who have been doing this work for 15 and four years, respectively—pursue their quarry from one camera to the next with humdrum efficiency, I can almost see their blood quicken. For what we have here, they believe, are two members of gangs that have been plaguing Islington for more than a year. They snatch smartphones from pedestrians, then sell the items on the black market. It happens about 50 times a week in the borough of nearly 233,000 residents.

And yet to the uninitiated, the prospect of catching the bikers in an illegal act can feel almost irrelevant. Instead, I'm captivated by the basic spectacle of two people who appear to have no idea they're being watched everywhere they go. Perhaps they're criminals. Perhaps they're sociopaths. Our surveillance is inconclusive on these matters. The only thing that's certain is that we see them but they don't see us. Like a deer framed in a hunting riflescope, the bikers display no signs of their vulnerability. In this way they are profoundly exposed.

That evening a few miles away, I'm sitting in a mobile trailer in southwest London, just down the street from the Vauxhall Underground Station. Beside me is an affable young man who goes by the name of Haz. Several closed-circuit screens are arrayed in front of us, displaying images provided by 10 cameras aimed at two nearby nightclubs.

CITY SURVEILLANCE

London authorities were early adopters of widespread closed-circuit television (CCTV) surveillance after the city was targeted by terrorists using truck bombs in the early 1990s. From 2012 to 2015 the city saw a 72 percent increase in cameras, making up one-third of the U.K.'s cameras overall. Today Londoners are some of the most closely watched city dwellers in the world; as one example, the borough of Islington, just north of central London, monitors 180 cameras.

JASON TREAT AND RYAN T. WILLIAMS, NGM STAFF. SOURCES: BIG BROTHER WATCH; ISLINGTON COUNCIL; ORDNANCE SURVEY, U.K.

Haz is here a couple of weekends a month. The nightclubs, Lightbox and Fire, wish to avoid legal troubles from drug deals by their patrons, so they've commissioned a mobile CCTV operator and former policeman, Gordon Tyerman, to have his man Haz keep an eye on the crowds. Occasionally a clubgoer happens to notice one of the cameras and responds by thrusting a middle finger or an exposed breast into Haz's field of vision. Otherwise, the thousands of young men and women entering and exiting the clubs are his unwitting entertainment.

"This is the best, most exciting job I've had so far," Haz says. "It's so unpredictable. Everything's quiet, and then suddenly a fight breaks out."

Haz sits in the trailer for 10 hours straight, eyes trained on the patrons. If he sees the makings of a drug deal or a fight, he notifies the club's in-house security by walkie-talkie. It amazes him how indiscreet drug dealers can be—with the bulges in their socks and their melodramatic handovers—despite the presence of security guards. "We ask them, 'How stupid can you be?' " he laughs. "And they take it as a challenge."

Tonight there are no drug deals, no fights, only the random foolishness of the young and inebriated. They stagger with linked arms down the middle of the street. They paw at each other. They get sick on the sidewalk. In their sudden aloneness, they break out in sobs. Though Haz maintains that he's gained "invaluable skills from this job," chiefly the skills he's honing are those of Vauxhall's invisible, after-hours anthropologist.

"There's stuff you see on CCTV," he marvels, "that makes you think, 'That's not adult behavior.' They tend to forget who they are."

But do they really tend to forget who they are? Or do they simply tend to forget that someone might be watching?

Shooter Detection Systems in Boston, Massachusetts, has invented a wall-mounted device (top left) designed to find an active shooter inside a building. The system uses acoustic software

In 1949, amid the specter of European authoritarianism, the British novelist George Orwell published his dystopian masterpiece *1984*, with its grim admonition: "Big Brother is watching you." As unsettling as this notion may have been, "watching" was a quaintly circumscribed undertaking back then. That very year, 1949, an American company released the first commercially available CCTV system. Two years later, in 1951, Kodak introduced its Brownie portable movie camera to an awestruck public.

Today more than 2.5 trillion images are shared or stored on the Internet annually—to say nothing of the billions more photographs and videos people keep to themselves. By 2020, one telecommunications company estimates, 6.1 billion people will have phones with picture-taking capabilities. Meanwhile, in a single year an estimated 106 million new surveillance cameras are sold. More than three million ATMs around the planet stare back at their customers. Tens of thousands of cameras known as automatic number plate recognition devices, or ANPRs, hover over roadways—to catch speeding motorists or parking violators but also, in the case of the United Kingdom, to track the comings and goings of suspected criminals. The untallied but growing number of people wearing body cameras now includes not just police but also hospital workers and others who aren't law enforcement officers. Proliferating as well are personal monitoring devices—dash cams, cyclist helmet cameras to record collisions, doorbells equipped with lenses to catch package thieves—that are fast becoming a part of many a city dweller's everyday arsenal. Even less quantifiable, but far more vexing, are the billions of images of unsuspecting citizens captured by facial-recognition technology and stored in law enforcement and private-sector databases over which our control is practically nonexistent.

Those are merely the "watching" devices that we're capable of seeing. Presently the skies are cluttered with drones—2.5 million of which were purchased in 2016 by American hobbyists and businesses. That figure doesn't include the fleet of unmanned aerial vehicles used by the U.S. government not only to bomb terrorists in Yemen but also to help stop illegal immigrants entering from Mexico, monitor hurricane flooding in Texas, and catch cattle thieves in North Dakota. Nor does it include the many thousands of airborne spying devices employed by other countries—among them Russia, China, Iran, and North Korea.

We're being watched from the heavens as well. More than 1,700 satellites monitor our planet. From a distance of about 300 miles, some of them can discern a herd of buffalo or the stages of a forest fire. From outer space, a camera clicks and a detailed image of the block where we work can be acquired by a total stranger.

In 2015 Peter Gold was shot while trying to rescue a woman who was being abducted at gunpoint. The incident was captured on a video camera; it shows a man shooting Gold in the

Gold returns to the New Orleans street where he was shot in 2015. Then a 25-year-old medical student, he had intervened when he saw a man later identified as Euric Cain attempt to drag a woman into a vehicle.

Simultaneously, on that very same block, we may well be photographed at unsettlingly close range perhaps dozens of times daily, from lenses we may never see, our image stored in databases for purposes we may never learn. Our smartphones, our Internet searches, and our social media accounts are giving away our secrets. Gus Hosein, the executive director of Privacy International, notes that "if the police wanted to know what was in your head in the 1800s, they would have to torture you. Now they can just find it out from your devices."

This is—to lift the title from another British futurist, Aldous Huxley—our brave new world. That we can see it coming is cold comfort since, as Carnegie Mellon University professor of information technology Alessandro Acquisti says, "in the cat-and-mouse game of privacy protection, the data subject is always the weaker side of the game." Simply submitting to the game is a dispiriting proposition. But to actively seek to protect one's privacy can be even more demoralizing. University of Texas American studies professor Randolph Lewis writes in his new book, *Under Surveillance: Being Watched in Modern America*, "Surveillance is often exhausting to those who really feel its undertow: it overwhelms with its constant badgering, its omnipresent mysteries, its endless tabulations of movements, purchases, potentialities."

The desire for privacy, Acquisti says, "is a universal trait among humans, across cultures and across time. You find evidence of it in ancient Rome, ancient Greece, in the Bible, in the Quran. What's worrisome is that if all of us at an individual level suffer from the loss of privacy, society as a whole may realize its value only after we've lost it for good."

Is a looming state of Orwellian bleakness already a fait accompli? Or is there a more hopeful outlook, one in which a world under watch in many ways might be better off? Consider the 463 infrared camera traps the World Wildlife Fund uses in China to monitor the movements of the threatened giant panda. Or the thermal imaging devices that rangers deploy at night to detect poachers in Kenya's Masai Mara National Reserve. Or the sound-activated underwater camera system developed by UC San Diego researchers that tracks the nearly extinct vaquita porpoise in the Sea of Cortez. Or the "forest watcher" cameras installed to help protect the shrinking timberlands of Sri Lanka.

FACIAL RECOGNITION

Face-scanning technology is evolving rapidly and is increasingly employed in high-security facilities such as airports and government offices. Now some stores are even using it to identify returning customers or shoplifters.

Finding a face

Systems extract patterns from an image and compare them to a model of a face. When patterns start to resemble the model, the system signals it has homed in on a face. Personal devices Checkpoint cameras, Other cameras, CCTV cameras, Smart phones use face recognition for apps and security, such as unlocking the phone.

Faces are recorded at customs and security checkpoints, and the images are archived. Laptop, video, and thermal cameras used in some security systems can capture face images. Systems can isolate and track individuals by face, gait, and clothing color and pattern.

Face imagery captured when a person poses for the camera, such as at security checkpoints, is easier to analyze; imagery captured from CCTV cameras may require advanced methods and detailed analysis.

Creating a face template

Algorithms build more informative and accurate digital representations—called face templates—using thermal, geometric, and other data, either separately or combined. Geometric, Photometric, Skin-texture analysis: Thermal sensors, Spatial relationships between facial features, such as the center of the eyes and tip of the nose, are calculated.

Algorithms can build a face even if an image is obscured by poor lighting or distorted by odd angles or expressions. Pores, wrinkles, and spots are mapped and analyzed; the technology can even differentiate between twins.

This technology can provide further information despite obstacles such as heavy makeup or disguises.

Identifying a face

Once a face template is created, it can be compared with databases (such as for mug shots) to verify a person's identity or recognize an individual in CCTV footage. Identity confirmed.

"If you want a picture of the future," Orwell darkly warned in his classic, "imagine a boot stamping on a human face—forever." This authoritarian vision discounts the possibility that governments might use such tools to make the streets safer. Recall, for example, the footage from security cameras that cracked the cases of the 2005 London subway and 2013 Boston Marathon bombings. Multitudes of more obscure episodes exist, such as that of Euric Cain, caught unambiguously on camera shooting a Tulane University medical student named Peter Gold in 2015 after Gold prevented him from abducting a woman on the streets of New Orleans. (Gold survived; Cain received a 54-year prison sentence for a crime rampage that included rapes, armed robbery, and attempted murder.)

At the Port of Boston, the Department of Homeland Security has tested a cargo-visualizing method invented by two MIT physicists, Robert Ledoux and William Bertozzi. Using a

technique known as nuclear resonance fluorescence—in which elements become identifiable by exciting their nuclei—the screening device can, without opening a freight container, discern the elemental fingerprint of its contents. Unlike a typical x-ray scan, which shows only shape and density, it can tell the difference between soda and diet soda, natural and manufactured diamonds, plastics and high-energy explosives, and nonnuclear and nuclear material.

Does anyone doubt that a more closely inspected world over the past 150 years would have been a safer one? We might know the identity of Jack the Ripper, whether Lee Harvey Oswald acted alone, and if O. J. Simpson acted at all. Of course, public safety has been the pretext for surveillance before and since Orwell's time. But today such technology can be seen as a lifesaver in more encompassing ways. Thanks to imagery provided by satellite cameras, relief organizations have located refugees near Mosul, encamped in the deserts of northern Iraq. And thanks to numerous space probes, scientists have proof that the world's climate is dramatically changing.

Could the great Orwell's imagination have failed? Could Big Brother save humanity, rather than enslave it? Or might both scenarios be true at the same time?

Dino Bertolino, a senior spacecraft technician at Planet, holds a camera-equipped satellite, which the San Francisco company calls a Dove. Planet has more than 150 of these shoe box–size satellites operating in orbit, snapping two images a second. With this fleet, when conditions are optimal, the company can photograph the Earth's entire landmass in a day. Photograph by Craig Cutler

These are a selection of images taken by 133 of Planet's Dove satellites operating on September 20, 2017. The company's ability to take photos of the same location every day makes it unique among satellite operators that make their images available to the public.

'There is an appetite in the U.K. for surveillance that I haven't seen anywhere else in the world," said Tony Porter, the world's only known surveillance camera commissioner, as we sat in the cafeteria of a London government office with CCTV cameras peering at us from the corners. A former police officer and counterterrorism specialist, Porter was recruited four years ago by Her Majesty's Home Office, responsible for the security of the realm, to lend a semblance of oversight to the country's ever growing surveillance state. With a paltry annual budget of $320,000, Porter and three staffers spend their workdays persistently urging, with some success, government and commercial users of surveillance cameras to comply with the relevant codes and guidelines. But beyond mentioning the names of the noncompliant in a report to Parliament, Porter's office has no powers of enforcement.

Nonetheless, his appraisal of the U.K. as the most receptive country in the world to surveillance technology is widely shared. London's network of surveillance cameras was first conceived in the early nineties, in the wake of two bombings by the Irish Republican Army in the city's financial district. What followed was a fevered spread of monitoring technology. As William Webster, a professor of public policy at the University of Stirling in Scotland and an expert on surveillance, recalls, "The rhetoric about public safety at the time was, 'If you've got nothing to hide, you've got nothing to fear.' In hindsight, you can trace that slogan back to Nazi Germany. But the phrase was commonly used, and it crushed any sentiment against CCTVs."

The city's original security infrastructure, known as the "ring of steel," was later expanded and augmented by ANPR technology on major thoroughfares. Now spread throughout the country are 9,000 such cameras, which photograph and store 30 million to 40 million images daily of every single passing license tag, not merely those of speeders or known criminals. As former Scotland police counterterrorism coordinator Allan Burnett observes, "It would be very difficult today to go through Scotland and not be seen by an ANPR camera."

"I'm pretty sure we now have more CCTVs per capita than any other city on the planet," the former U.K. deputy prime minister, Nick Clegg, told me as he sat in his London office, watched by a camera across the street trained directly on his back. "And basically, it's happened without any meaningful public or political debate whatsoever. Partly it's because we don't have the history of fascism and nondemocratic regimes, which in other countries have instilled profound suspicion of the state. Here it feels benign. And as we know from history, it's benign until it isn't."

Elements of fear and romance help explain the profusion of surveillance in the U.K. This, after all, is a country saved by espionage: The museum commemorating the legendary World War II code breakers at Bletchley Park, 40 miles northwest of London, is today a much visited site. So, for that matter, is the London Film Museum's permanent exhibit on the dashing spy James Bond, a creation of the writer and former British naval intelligence officer Ian Fleming. Agent 007 is bound up in the nation's postwar self-appraisal, but so is the jolting reality that the U.K. was one of the first countries to face the constant fear of terrorist attacks. When it comes to protecting its people, the British government is viewed in a more appreciative light than perhaps those of other free societies. Even after the revelations by former U.S. National Security Agency contract employee Edward Snowden that American and British intelligence agencies had been collecting bulk data from their own citizens—a disclosure that triggered calls for reform by both political parties in the U.S.—Parliament essentially enshrined those powers in late 2016 by passing the Investigatory Powers Act with scant public outcry.

As David Omand, the former director of the Government Communications Headquarters—one of the British intelligence agencies shown by Snowden to be collecting bulk data—put it to me: "On the whole we see our government as efficient and benign. It runs the National Health Service, public education, and social security. And thank God, we haven't been through the experience of the man in the brown leather trench coat knocking on the door at four in the morning. So when we talk about government surveillance, the resonance is different here."

That's not by any means to say that a country like the United States, with its more skeptical view of big government, is wholly immune to surveillance creep. Most of its police departments are now using or considering using body cameras—a development that, thus far at least, has been cheered by civil liberties groups as a means of curbing law enforcement abuses. ANPR cameras are in many major American cities as traffic and parking enforcement tools. In the wake of the September 11 attacks, New York City ramped up its CCTV network and today has roughly 20,000 officially run cameras in Manhattan alone. Meanwhile, Chicago has invested heavily in its network of 32,000 CCTV devices to help combat the murder epidemic in its inner city.

But other U.S. cities with no history of terrorist attacks and relatively low violent crime rates also have embraced surveillance technology. I checked out the CCTV network that has quietly spread throughout downtown Houston, Texas. As recently as 2005, the city didn't have a single such camera. But then Dennis Storemski, the director of the Mayor's Office of Public Safety and Homeland Security, began touring other cities. "Basically, it was what I saw in London that got me interested in the technology," he recalls. Today, thanks to federal grants, Houston has 900 CCTV cameras, with access to an additional 400. As in London, officials don't monitor every camera every minute—and as such, Storemski says, "it's not surveillance per se. We've wanted to take away the expectation that people are watching." Perhaps for that reason, Houston's CCTV reach will soon expand well beyond downtown, but—in a state hardly known as trusting of government—without the slightest drama.

In the 1960s the U.S. Army Corps of Engineers built more than 270 concrete crosses, 60 feet wide, in the Arizona desert. The known dimensions helped calibrate the world's first spy satellites. To create the image above, two artists photographed the cross, tracked the trajectories of satellites that pass overhead, and drew arcs in the sky showing their paths. Photograph by Julie and Damon Sauer

Similarly, the acquiescence among the British to the proliferation of cameras is as striking as any sound of silence could possibly be. CCTV and ANPR cameras—and the signs announcing them (though by no means all of them)—blend in as drab companions to the rest of the city's infrastructure. During three weeks in London, I strolled through the quiet neighborhoods where Orwell and Huxley once resided. Orwell's house, on Canonbury Square in Islington, is within view of several CCTV and ANPR cameras and is a mere four-minute walk from the borough's control room. For its part, the former Huxley residence a few miles away is under constant watch in an impregnable steel-reinforced control room.

Outside of the city in the county of South Yorkshire, I visited Barnsley Hospital, where some security personnel are equipped with body cameras to discourage unruly behavior by patients or visitors. Similar cameras, it was reported during my stay, were being tested for use by schoolteachers. Given that an estimated 150,000 British police officers are already equipped with such devices, perhaps it's an effortless next step to contemplate them on other authority figures, such as educators and nurses. From there, however, who's next? Flight attendants? Postal workers? Psychologists? Human resource directors?

"Some local authorities are seeking to compel taxi drivers to use surveillance," Porter, the surveillance camera commissioner, told me. "Considering that, and the use of body cameras in hospitals and schools, the question I'd put forward is: What kind of society do we want to live in? Is it acceptable for all of us to go around legitimately filming each other, just in case somebody commits a wrong against us?"

SATELLITES

More than 1,700 satellites orbit above us, some as much as 100,000 miles overhead. They collect images and other data, broadcast information, track our locations, and even listen to our conversations. U.S. Public institutions and companies operate most satellites, with commercial launches already far outstripping the government's.

About 60 countries operate the remaining satellites in orbit.

I thought about this last question during my final days ambling along the well-scrubbed streets of London, my eyes now keenly attuned to the cyclops-like glares from corners and lampposts. As my path inevitably led me to the famed Westminster Bridge over the River Thames, I found myself engulfed by tourists of various nationalities holding up smartphones in an attempt to produce the ultimate London selfie. I ducked and turned and apologized before realizing it was futile. And these were just the cameras in front of my face. Were all of my movements being casually documented in this way? Did it really make any difference whether Big Brother was watching, given that everyone is already watching everyone else?

I'd been discussing society's growing pics-or-it-didn't-happen fixation with two keen observers. The first, Chloe Combi, is a former schoolteacher whose first book, *Generation Z: Their Voices, Their Lives,* is the fruit of hundreds of hours of interviews she conducted with British teenagers. They demonstrated a remarkable nonchalance about being photographed and filmed in almost every conceivable setting. "You can watch a documentary of someone's entire life on their phone," Combi told me. "We live in a world where, increasingly, nothing remains secret. And one of the signs of true wealth and power may end up being that privacy will become a commodity only for those who have the serious money to buy it. For everybody else, all the world really will be a stage, with all the people on it self-consciously playing their role."

The futurist spectacle conjured up by Combi—one in which everyone is simultaneously voyeur and exhibitionist, 24/7—struck me as a somewhat egalitarian version of *1984* and *Brave New World,* yet no less dystopic. Are we already there, at the endpoint of what University of Kansas sociologist William Staples in 2000 called the "state of permanent visibility," except by our own acquiescence rather than by governmental force? Our visual constellation is replete with adorable babies, kittens, and elephants—but also ISIS beheadings, celebrities in sexual congress, double-speaking politicians, police shootings of unarmed civilians. Meanwhile, we're seen, up close and far too personally, by airport-security screeners, "smart" billboards that tailor ads to us based on our appearance, and everyone who knows everyone who caught us on camera on a day when we could swear we were alone.

Whether this all adds up to a more enlightened society, an overstimulated one, or a little bit of both is hard to say. I solicited the thoughts of Susan Greenfield, a research neuroscientist and renowned critic of social media obsessives, who also happens to be a member of the British Parliament. Baroness Greenfield's assessment was no less stark than Combi's. "The notion of privacy, of privation, is shutting something out," she said. "We need to cut ourselves off. Everyone seems to think that it's great to be connected and exposed all the time. But what happens when everything is literal and visual? How do you explain a concept like honor when you can't find it on Google Images? The universe of the abstract is inexplicable. The nuance in life disappears."

Three telescopes of the Deimos Sky Survey, based in Spain, watch for close asteroids and man-made space debris that could damage satellites, as an airplane streaks across the sky. Noelia Sánchez Ortiz, an aerospace engineer, and Jaime Nomen, an astronomer and the head of the observatory, monitor the instruments. Photograph by Luca Locatelli

And so as I talked with Tony Porter in the cavernous and highly surveilled cafeteria of the Home Office, I found myself repeating something I'd expressed to him once before, months earlier: Didn't this whole fear-of-Big-Brother impulse seem rather quaint now?

"I now use that term in my speeches," the surveillance camera commissioner informed me with a pleased grin. Then he turned serious. Porter had recently visited the United Arab Emirates, a federation of monarchies that suppresses dissent and has a great deal of interest in surveillance technology. That struck Porter as ominous. "I get where you're coming from," he said. "But surveillance by the state is invasive, it's powerful, it's capable of connectivity beyond people's wildest imaginations. That's completely different from, say, a selfie.

"Look," he went on, "the real threat is when we move towards integrated surveillance. Large retailers are spending millions of pounds looking at every conceivable element of this. I'm a middle-aged fat guy; I walk into a supermarket and immediately on the intercom they start advertising for croissants. What if it gets more sinister, and from my Facebook profile they can target my daughter and ask where she shops? Who's going to regulate that? Or does it not need to be regulated? Is the horse already out of the barn? Is it already 'quaint'?"

Thermal imaging cameras, provided by the World Wildlife Fund to the Mara Conservancy, have allowed rangers in Kenya's Masai Mara National Reserve to extend their work protecting wildlife into the night.

The seemingly minute-by-minute advancements in surveillance technology can, to some civil libertarians, take on the appearance of a runaway bullet train. As Ross Anderson, professor of security engineering at the University of Cambridge, warns, "We need to be thinking ahead to the next 20 years. Because that's when you'll have augmented reality, an Oculus Rift 2.0, with at least 8,000 pixels per inch. So, sitting in the back of a lecture hall, you can read the text on a lecturer's phone. At the same time, the one hundred CCTVs in that lecture hall will be able to see the password you're punching into your phone."

Even Huxley, whose masterwork presents a forbidding view of a hyper-industrialized London in the year 2540, didn't conceive of a world so acutely visualized that our most intimate secrets can't always be concealed. Where would that leave us? On the one hand, it stretches credulity to imagine the willful suppression of such tools. Says David Anderson, a London barrister who spent six years as the government's independent reviewer of counterterrorism legislation, "Either you think technology has presented us with strong powers that the government should use with equally strong safeguards, or you believe this technology is so scary we should pretend it's not there. And I'm firmly in the first category—not because I say government is to be trusted, but instead because in a mature democracy such as this one, we're capable of constructing safeguards that are good enough for the benefits to outweigh the disadvantages."

On the other hand, allowing such technological progress to find its way into a largely unregulated marketplace seems equally imprudent. Jameel Jaffer, the founding director of Columbia University's Knight First Amendment Institute, says, "I do think that we live increasingly recorded and tracked lives. And I also think we're only starting to grapple with the implications of that, so before we adopt new technologies or before we permit new surveillance

forms to entrench themselves in our societies, we should think about what the long-term implications of those surveillance technologies will be."

How to craft such judgments? Endeavoring to do so is particularly nettlesome when a breakthrough occurs that explodes our notion of how we can view the world. In fact, a game changer of this sort has already emerged. The technology in question can monitor the Earth's entire landmass every single day. It's the brainchild of a San Francisco–based company called Planet, founded by three idealistic former NASA scientists named Will Marshall, Robbie Schingler, and Chris Boshuizen.

Their headquarters resides in an unprepossessing warehouse in the gritty South of Market neighborhood. The tableau inside is textbook Silicon Valley: more than 200, mostly young techies in aggressively casual dress hunched silently over their keyboards in an open work space, aside from a few conference rooms named after some of the company's heroes—among them, Galileo, Gandhi, and Al Gore. I sat in one of them overlooking the upscale employee cafeteria, where lunch would later be followed by a happy hour of Napa wines and California microbrews.

Locating nuclear material

Seaports handle roughly 80 percent of worldwide trade by volume and play a vital role in border security. In a pilot program at the Port of Boston, scientists and engineers have designed an advanced scanner that can identify the molecular makeup of substances with far more specificity than ever before, quickly differentiating, for example, between salt and cocaine.

As the 3-D model is being created, a detector scans the cargo for neutrons, produced when x-rays interact with nuclear material. When the data are combined with the 3-D model, an operator can pinpoint the location of any nuclear contraband.

Marshall and Schingler joined me. The former is a lanky Brit with wire-frame glasses; the latter, a broad-shouldered and easygoing Californian. Both are 39 and seemed fully recovered from their dinner the previous evening to celebrate the fifth anniversary of when they started working full time at Planet. At NASA they had been captivated by the idea of taking pictures from space, especially of Earth—and for reasons that were humanitarian rather than science based.

They experimented by launching ordinary smart phones into orbit, confirming that a relatively inexpensive camera could function in outer space. "We thought, What could we do with those images?" Schingler said. "How can we use these things for the benefit of humanity? List the world's problems: poverty, housing, malnutrition, deforestation. All of these problems are more easily addressed if you have more up-to-date information about our planet. Like you wake up in a few years and you find there's a hole in the Amazon forest. What if we could have supplied information about this more rapidly to the Brazilian government?"

In storybook fashion, Marshall and Schingler developed their first model in a garage in Silicon Valley. The idea was to design a relatively low-cost, shoe box–size satellite to minimize the military-scale budgets often required for designing such technology—and then, as Marshall told me, "to launch the largest constellation of satellites in human history." By deploying many such devices, the company would be able to see daily changes on the Earth's surface in totality.

These tiny U.S. Navy drones (basically just aerodynamic circuit boards) were designed to be carried aloft and then dropped as a swarm. They could be used for many applications, such as monitoring hurricanes, setting up a trip wire along a border, or guiding farmers as they seed a field.

In 2013 they launched their first satellites and received their first photographs, which provided a far more dynamic look at life around the world than previous global mapping imagery. "The thing that surprised us most," said Marshall, "is that almost every picture that came down showed how the Earth was changing. Fields were reshaped. Rivers moved. Trees were taken down. Buildings went up. Seeing all of this completely changes our concept of the planet as being static. And instead of just having a figure about how much a country has been deforested, people can now be motivated by pictures that show the deforestation taking place."

Today Planet has more than 200 satellites in orbit, with about 150 it calls Doves that can image every bit of land every day when conditions are right. Planet has ground stations as far away as Iceland and Antarctica. Its clients are just as varied. The company works with the Amazon Conservation Association to track deforestation in Peru. It has provided images to Amnesty International that document attacks on Rohingya villages by security forces in Myanmar. At the Middlebury Institute's Center for Nonproliferation Studies, recurring global imaging helps the think tank watch for the sudden appearance of a missile test site in Iran or North Korea. And when *USA Today* and other publications wanted an aerial image of the Shayrat air base in Syria before and after it was bombed by the U.S. military last April in retaliation for a chemical attack on a rebel-held Syrian town, the news organizations knew whom to call.

Those are pro bono clients. Its paying customers include Orbital Insight, a Silicon Valley–based geo-spatial analytics firm that interprets data from satellite imagery. With such visuals, Orbital Insight can track the development of road or building construction in South America, the expansion of illegal palm oil plantations in Africa, and crop yields in Asia. In the company's conference room, James Crawford, the chief executive, opened his laptop and showed me aerial views of Chinese oil tanks, with their floating lids indicating they were about three-quarters full. "Hedge funds, banks, and oil companies themselves know what's in their tanks," he said with a sly grin, "but not in others', so temporal resolution is extremely important." Crawford's firm also employs Planet's optical might to charitable ends. For example, it conducts poverty surveys in Mexico for the World Bank, using building heights and car densities as proxies for economic well-being.

Meanwhile, Planet's marketing team spends its days gazing at photographs, imagining an interested party somewhere out there. An insurance company wanting to track flood damage to homes in the Midwest. A researcher in Norway seeking evidence of glaciers eroding. But what about … a dictator wishing to hunt down a roving dissident army?

Here is where Planet's own ethical guidelines would come into play. Not only could it refuse to work with a client having malevolent motives, but it also doesn't allow customers to stake a sole proprietary claim over the images they buy. The other significant constraint is technological. Planet's surveillance of the world at a resolution of 10 feet is sufficient to discern the grainy outline of a single truck but not the contours of a human. Resolution-wise, the current state of the

art of one foot is supplied by another satellite imaging company, DigitalGlobe. But for now, only Planet, with its formidable satellite deployment, is capable of providing daily imagery of Earth's entire landmass. "We've run the proverbial four-minute mile," Marshall said. "Simply knowing it's possible doesn't make it any easier."

Still, Planet has blazed a trail. Others someday will follow it. When they do, how will they harness the power to see so much of the globe, every single day? Will their aims be as benevolent as those of Planet? Will they try to perfect satellite photography that's higher in resolution and thus in invasiveness? Marshall doesn't see how this is possible. "To identify a person from 300 miles away, you'd need a camera the size of a bus," he told me. And in any event, he added, an American firm seeking to accomplish that would encounter considerable federal regulatory hurdles.

Of course, regulations can be changed. So can the boundaries of our technological limits. Just a year or two ago, the owner of the largest number of functioning satellites in orbit was the U.S. government, with roughly 170. Now Planet prevails over the heavens in greater numbers than the most powerful nation on Earth.

Who is next in line to be the Biggest Brother?

On a bracing autumn evening in San Francisco, I returned to Planet to see the world through its all-encompassing lens. More than a dozen clients would be there to show off how they're using satellite imagery—what it meant, in essence, to see the world as it's changing.

I zigzagged among semicircles of techies gathered raptly around monitors. Everywhere I looked, the world came into view. I saw, in the Brazilian state of Pará, the dark green stretches of the Amazon jungle flash red, prompting automatic emails to the landowners: *Warning, someone is deforesting your land!* I saw the Port of Singapore teem with shipping activity. I saw the croplands of southern Alberta, Canada, in a state of flagging health. I saw an entire network of new roads in war-wracked Aleppo, Syria—and for that matter, a new obstruction in one of those roads, possibly a crater from a bomb attack. I saw oil well pads in Siberia—17 percent more than in the previous year, a surprising sign of stepped-up production that seemed likely to prompt frantic reassessments in the world's oil and gas markets.

Dubbed the "fifth largest intelligence agency," more than 850,000 volunteers—retirees outfitted with official red vests or armbands—are the eyes and ears of their Beijing, China

A tall young man named John Goolgasian wanted to show me how his less than year-old Virginia-based outfit called GeoSpark Analytics was matching crime data with Planet images. After a few clicks, we were staring at neighborhoods in Nigeria that had been overtaken by the extremist group Boko Haram. More clicks and the crescent-shaped coastline that materialized was one I'd visited nine years before: Mogadishu, Somalia, bearing fresh scars from that week's deadly bomb attacks by al Shabaab. A few more clicks and the image was even more familiar: my neighborhood in Washington, D.C.—specifically, a few blocks from my house, where a burglary report had just been called in.

Planet's hosts halted the show-and-tell to say a few words. Andy Wild, the chief revenue officer, spoke of the new frontier in a slightly quavering voice. It was one thing to achieve, as Wild put it, "a daily cadence of the entire landmass of the Earth." Now the custodians of this technology had to "turn it into outcomes." Tom Barton, the chief operating officer, said, "I hope one year from now, we're here saying, 'Holy shit, we really did change the world.' "

I was pondering the implications of this when a young woman showed me what was on her laptop. Her name was Annie Neligh, an Air Force veteran who now leads "customer solutions engineering" at Planet. One of Neligh's customers needing a solution was a Texas-based insurance company. The company suspected that it was renewing insurance policies for homeowners who weren't disclosing that they'd installed swimming pools—a 40 percent loss on each policy for the company. So it had asked Planet to provide satellite imagery of homes in Plano, Texas.

Neligh showed me what she'd found. Looking at a neighborhood of 1,500 properties, we could clearly see the shimmering shapes of 520 small bodies of water—a proportion far in excess of what the insurance company's customers had claimed. Neligh shrugged and offered a thin smile. "People lie, you know," she said.

Now her client had the truth. What would it do with this information? Conduct a surprise raid on the somnolent hamlets of Plano? Jack up premiums? Order images that might show construction crews installing new Jacuzzis and Spanish tile roofs? The future is here, and in it, truth is more than a kindly educator. It is a weapon—against timber poachers and burglars and mad bombers and acts of God, but also against the lesser angels of our nature. People lie, you know. The age of transparency is upon us.

As I walked back to my hotel, I thought about the two moped riders in Islington, as I often had in the months since I surveilled them. I wondered if they had been arrested. I wondered if they were guilty of anything at all, apart from the crime of being conspicuously interesting on an otherwise dull morning. I wondered if they would ever know that unseen strangers had been watching them, just as a stranger might now be watching me—someone somewhere squinting into a CCTV monitor at the spectacle of a lone figure walking fast on a dark and otherwise vacant street on a chilly night without a coat on, as if in flight from something.

Robert Draper is a contributing writer for the magazine. His previous feature, about young technology entrepreneurs in Africa, ran in the December 2017 issue.