

The Tech and Design Issue / November 12, 2017

The New York Times Magazine



LIFE
AFTER
DRIVING

IMAGINING
A WORLD
OF AUTONOMOUS
CARS.

WATERLINE SQUARE RETHINK HOW YOU LIVE

All images are artists' renderings. The complete offering terms are in the Offering Plan for the respective property, available from the applicable Sponsor: RCB1 RESIDENTIAL FOR SALE LLC, RCB3 RESIDENTIAL FOR SALE LLC, or RCB4 RESIDENTIAL FOR SALE LLC. Sponsors' address: 1345 Avenue of the Americas, New York, NY, 10105. File Nos.: CD16-0170, CD16-0351, and CD16-0352. Equal Housing Opportunity.





Three soaring waterfront condominium towers where Midtown meets the Upper West Side.

Designed by Richard Meier, Kohn Pedersen Fox, and Rafael Viñoly.

100,000 square feet of sports, leisure, and lifestyle amenities and a new 2.6-acre park.

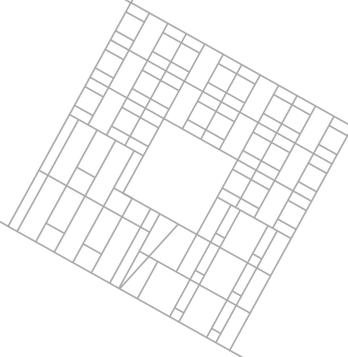
A dining and food hall experience by world-renowned Cipriani.

CONDOMINIUM RESIDENCES STARTING AT \$2 MILLION

ANTICIPATED 20-YEAR 421A TAX ABATEMENT

SALES GALLERY NOW OPEN

212 586 8333 WATERLINESQUARE.COM



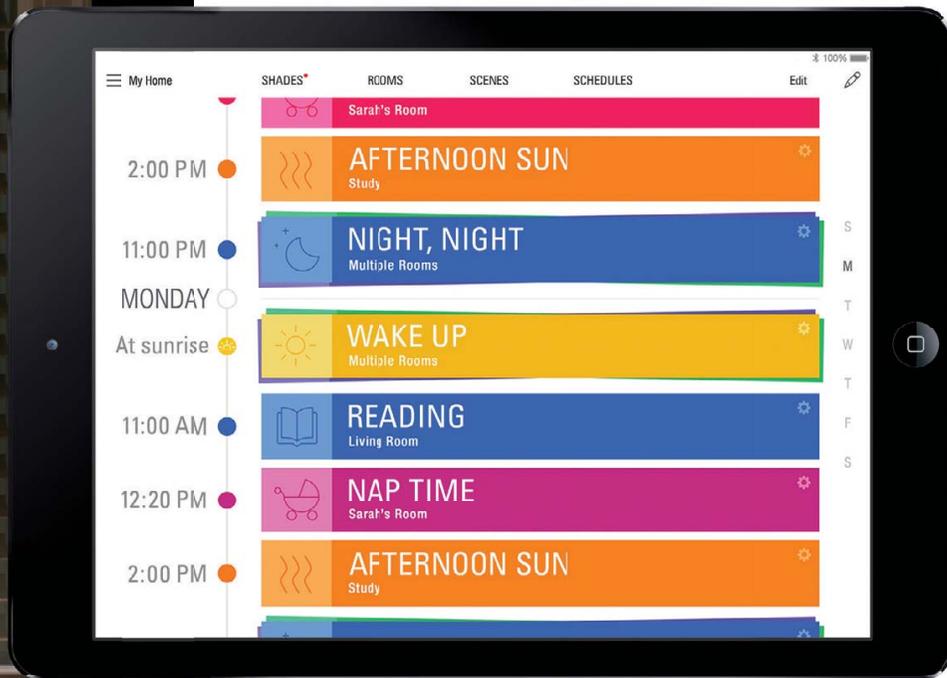
G|I|D
DEVELOPMENT

CS
corcoran sunshine
MARKETING GROUP



“Sweet dreams,”

said the window treatments
as they lowered themselves
for the night.



Meet PowerView® Motorization, the system that automatically moves your window shades according to schedules you set—from sunrise to sunset and everything in between—to make each moment in your home more beautiful.

The world's most stylish shades are now the smartest, too.



NORTHERN
TRUST

Never settle for less
than the best.

BEST PRIVATE
BANK
(U.S.)

-Financial Times Group, 2017

BEST PRIVATE
BANK
for Family Offices
(Global)

-Financial Times Group, 2017

BEST PRIVATE
BANK
for Succession
Planning
(U.S.)

-Financial Times Group, 2017

We are honored to be named the Financial Times Group's Best Private Bank in the U.S., Best Private Bank for Family Offices and Best Private Bank in the U.S. for Succession Planning. These awards recognize — among other reasons — dynamic asset growth in our goals-based wealth management program, low ratio of clients per advisor and outstanding transparency.

To experience our best, call 866-803-5857 or visit northerntrust.com/best.

ACHIEVE GREATER

INVESTING \ BANKING \ TRUST & ESTATE SERVICES \ WEALTH PLANNING \ FAMILY OFFICE

The Northern Trust Company \ Member FDIC. © 2017 Northern Trust Corporation. 2017 Global Private Banking Awards presented by Professional Wealth Management and The Banker.

Three Ways Successful Women Manage Their Wealth

As women gain more control of the world's wealth — about 30 percent last year, up 5 percent from 2011 — their role as stewards of their families' finances continues to evolve. Affluent, educated career women take a three-pronged approach to managing their families' wealth.

Focus on Financial Goals

Claudia Sangster, director of Family Education and Governance, Wealth Planning Advisory Services for Northern Trust, says many successful women are strategic about their money. "Women are much more likely [than men] to make a goal and invest toward that goal. They're not just in it to be competitive, to see if they can beat the markets or the benchmark," Sangster explains. "They're much more likely to sit down with an advisor and map out a financial lifeline of 'Here's what I want to accomplish and when.'"

Create a Financial Legacy

Successful women build a strong financial legacy, says Maxine Bédard, cofounder and CEO of Zady, a New York City-based "slow-fashion" company that encourages customers to "make conscious purchases by investing in longevity, not the latest trend." Bédard believes it's important to align her deeds and financial decisions with her social conscience. She founded

the nonprofit Bootstrap Project in 2010 to help women artisans in developing countries start businesses. "Helping women start businesses is such a powerful way to give a hand up instead of a hand out, and provide them with the same tools you and I have access to," she says.

Pass on Financial Literacy

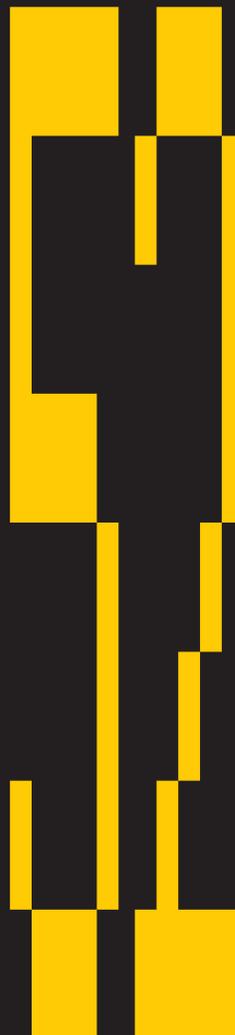
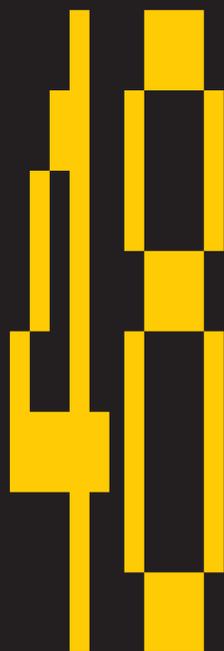
Many women recognize the value of starting early with their own families. "Raising children to value work and equipping them to be financially independent is important to women today," says Suzanne Shier, senior vice president and director of Wealth Planning and Tax Strategy for Wealth Management at Northern Trust. This approach offers multiple benefits, such as building kids' confidence and opening channels of communication within the family. Stripping money of its secrecy is vital, Sangster says. She urges women to seize opportunities to talk about wealth with their children and put it in context.



Maxine Bédard sits in her home, among many of the objects she has collected from her travels around the world. These mementos inspire her, she says. T Brand Studio

I think it's important to invest your dollars in the issues you believe in.

Maxine Bédard, cofounder and CEO of New York City-based "slow-fashion" company Zady.



DETROIT HUSTLE

Can Ford, an emblem and engine of the 20th century, turn itself into a tech company?

By Kevin Roose

THE REV-UP

What would happen if 20% of cars were autonomous? Life on the road would get amazing — and awkward.

IN FORMATION

Amid the race to make cars autonomous, can they also be made to cooperate?

By Kim Tingley

FULL TILT

If 100% of cars ever drive themselves, our familiar car culture would die — and a new one would arise.

WHAT TESLA SEES

For Elon Musk's company, autonomous driving is just a pit stop on the road to a better planet.

By Jon Gertner

Love at First Light

A COLLABORATION OF DESIGN VISIONARIES.

KPF. DAVID ROCKWELL. DAVID MANN. EDMUND HOLLANDER.

Two-bedroom Tribeca residences priced from \$4.3M
Occupancy early 2018

111MURRAY.COM | TEL. 212.776.1110

A PARTNERSHIP OF FISHER BROTHERS, WITKOFF AND NEW VALLEY
EXCLUSIVE MARKETING AND SALES AGENT: DOUGLAS ELLIMAN DEVELOPMENT MARKETING

This advertisement is not an offering. The complete offering terms are in an offering plan available from the Sponsor: Henry V Murray Senior LLC, 299 Park Ave, New York, NY 10171. File No. CD14-0363.
Equal Housing Opportunity. All images are artist's renderings and are provided for illustrative purposes only. Sponsor makes no representations or warranties except as may be set forth in the Offering Plan.

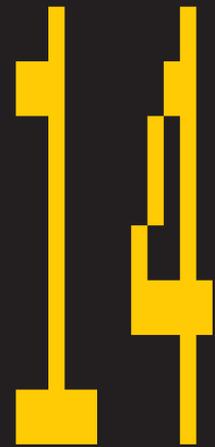
111
one eleven
MURRAY STREET



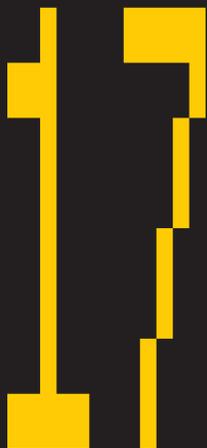
CONTRIBUTORS

'SELF-DRIVING
CARS WILL
CREATE NEW
POWER CENTERS,
NEW CRIMES,
JUST AS THEY
WILL CREATE NEW
COUNTERPOWERS,
NEW FORMS
OF REBELLION.'

Page 17

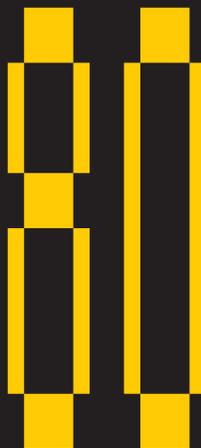


THE THREAD



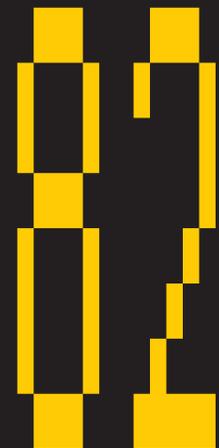
INTRODUCTION

By Bill Wasik



PUZZLES

More puzzles on Page 78
(Puzzle answers on Page 77)



ENDPAPER:
THE MUSEUM OF DRIVING

By Tomi Um

BEHIND THE COVER Gail Bichler, design director: "The time when self-driving cars will dominate the roads can seem far off. For the cover of our Tech and Design Issue, we chose to fast-forward to that time and look back. Vik Muniz's image of an abandoned steering wheel is both elegiac and filled with life, acknowledging that with the gains made through technology, there are also inevitable losses." Photograph by Vik Muniz for The New York Times.

Cancer is smart . . . and relentless. At Dana-Farber, we are too. Each year, we conduct over 800 clinical trials

THINK LIKE

giving patients access to the latest advances. And, in partnership with Brigham and Women's Hospital

CANCER

and Boston Children's Hospital, we're mapping out the genetic weaknesses of 25,000+ tumors to create

TO BEAT

precision treatments that destroy cancer. These are just a few reasons why U.S. News & World Report



CANCER

has recognized us as a national leader in cancer for 17 years straight. It's also why, here, cancer is quickly losing ground.



Beat cancer once...and for all. Visit dana-farber.org/beatcancer



HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL



Photographed by Kathy Ryan at *The New York Times* on Oct. 27, 2017, at 4:39 p.m.

Kevin Roose

"Detroit Hustle,"
Page 24

Kevin Roose is a business-and-technology columnist for *The Times* and a writer at large for the magazine. He went to Detroit to assess the future of self-driving cars at Ford, the company that started the first automotive revolution and desperately wants to be part of the second. "The battle for driverless cars is the 21st-century space race, with fierce rivalries, insane technical obstacles and billions, possibly trillions of dollars on the line," he says. "But there's an asymmetry to the fight. For Silicon Valley, this is a cool science project that might produce some positive side effects. For Ford and other automakers, it's much more existential — the entire future of their industry is on the line."

Jon Gertner

"What Tesla Sees,"
Page 64

Jon Gertner writes frequently for the magazine about science and technology. His last feature was about NASA's Grace climate satellites.

Vik Muniz

Cover

Vik Muniz is an artist who lives and works in Brooklyn and Rio de Janeiro. He is writing a book about photography and establishing a nonprofit school in Rio de Janeiro.

Kim Tingley

"In Formation,"
Page 48

Kim Tingley is a contributing writer for the magazine. Her last feature was about the engineers behind NASA's Voyager probes.

Tomi Um

Illustrations
throughout the issue

Tomi Um is a Brooklyn-based illustrator whose work can be seen in various places from the magazine's *Ethicist* column to Casper mattress ads. She is working on a children's picture book.

Dear Reader: Would You Prefer A Public Shaming?

Every week the magazine publishes the results of a study conducted online in June by *The New York Times's* research-and-analytics department, reflecting the opinions of 2,903 subscribers who chose to participate. This week's question: *Would you rather have done a horrible thing that only you know about, or have everyone think you did a horrible thing that you didn't do?*



72% Have done a horrible thing that only I know about



28% Have everyone think I did a horrible thing that I didn't do

Editor in Chief
Deputy Editors

JAKE SILVERSTEIN
JESSICA LUSTIG,
BILL WASIK

Managing Editor

ERIKA SOMMER

Design Director

GAIL BICHLER

Director of Photography

KATHY RYAN

Art Director

MATT WILLEY

Features Editor

ILENA SILVERMAN

Politics Editor

CHARLES HOMANS

Special Projects Editor

CAITLIN ROPER

Story Editors

NITSUH ABEBE,

MICHAEL BENOIST,

SHEILA GLASER,

CLAIRE GUTIERREZ,

LUKE MITCHELL,

DEAN ROBINSON,

WILLY STALEY,

SASHA WEISS

Associate Editors

JEANNIE CHOI,

JAZMINE HUGHES

Chief National Correspondent

MARK LEIBOVICH

Staff Writers

SAM ANDERSON,

EMILY BAZELON,

TAFFY BRODESSER-AKNER,

SUSAN DOMINUS,

MAUREEN DOWD,

NIKOLE HANNAH-JONES,

JONATHAN MAHLER,

WESLEY MORRIS,

JENNA WORTHAM

Writers at Large

C. J. CHIVERS,

PAMELA COLLOFF,

NICHOLAS CONFESSORE,

JOHN ISMAY,

KEVIN ROOSE,

JIM RUTENBERG

JOHN HERRMAN

RODRIGO DE BENITO SANZ

DEB BISHOP

BEN GRANDGENETT

RACHEL WILLEY

JESSICA DIMSON

STACEY BAKER,

AMY KELLNER,

CHRISTINE WALSH

JENNA PIROG

ROB HOERBURGER

HARVEY DICKSON,

DANIEL FROMSON,

MARGARET PREBULA,

ANDREW WILLETT

NANDI RODRIGO

ROBERT LIGUORI,

RENÉE MICHAEL,

LIA MILLER,

STEVEN STERN,

MARK VAN DE WALLE

ANICK PLEVEN

PATTY RUSH,

HILARY SHANAHAN

LIZ GERECITANO BRINN

David Carr Fellow

JOHN HERRMAN

Digital Art Director

RODRIGO DE BENITO SANZ

Special Projects Art Director

DEB BISHOP

Deputy Art Director

BEN GRANDGENETT

Designer

RACHEL WILLEY

Deputy Photo Editor

JESSICA DIMSON

Associate Photo Editors

STACEY BAKER,

AMY KELLNER,

CHRISTINE WALSH

Virtual Reality Editor

JENNA PIROG

Copy Chief

ROB HOERBURGER

Copy Editors

HARVEY DICKSON,

DANIEL FROMSON,

MARGARET PREBULA,

ANDREW WILLETT

NANDI RODRIGO

ROBERT LIGUORI,

RENÉE MICHAEL,

LIA MILLER,

STEVEN STERN,

MARK VAN DE WALLE

ANICK PLEVEN

PATTY RUSH,

HILARY SHANAHAN

LIZ GERECITANO BRINN

Publisher: ANDY WRIGHT **Advertising Directors:** MARIA ELIASON (Luxury and Retail) ● MICHAEL GILBRIDE (Fashion, Luxury, Beauty and Home) ● SHARI KAPLAN (Live Entertainment and Books) ● NANCY KARPFF (Fine Arts and Education) ● MAGGIE KISELICK (Automotive, Technology and Telecom) ● SCOTT M. KUNZ (International Fashion) ● JOHN RIGGIO (Recruitment) ● JOSH SCHANEN (Media, Studios and Travel) ● ROBERT SCUDDER (Advocacy) ● SARAH THORPE (Corporate, Health Care, Liquor and Packaged Goods) ● BRENDAN WALSH (Finance and Real Estate) **National Sales Office Advertising Directors:** KYLE AMICK (Atlanta/Southeast) ● LAUREN FUNKE (Florida/Southeast) ● MAGGIE KISELICK (Detroit) ● CHRISTOPHER REAM (Los Angeles/San Francisco/Northwest) ● JIMMY SAUNDERS (Chicago/Midwest) ● ROBERT SCUDDER (Boston/Northeast/Washington) ● KAREN FARINA (Magazine Director) ● MARILYN McCaULEY (Managing Director, Specialty Printing) ● THOMAS GILLESPIE (Manager, Magazine Layout). To advertise, email karen.farina@nytimes.com.



DBOX

One Hundred East Fifty Third Street By Foster+ Partners

RFR, Owner / Developer
Vanke, Owner
Foster + Partners, Architecture
William T. Georgis, Interior Design
Hines, Co-Developer
Compass, Sales & Marketing
Classic Marketing, Sales & Marketing

Modern Residences World-class Dining Exclusive Amenities

The residences at One Hundred East Fifty Third Street offer modern living for traditional and pied-à-terre lifestyles surrounded by world-class cuisine, art, shopping, and global businesses in Manhattan's Midtown Cultural District.

Extensive amenities include a casual all day restaurant and fine dining restaurant by celebrity chef Joël Robuchon; a 60-foot sunlit swimming pool; multilevel wellness facility; library; and global, hotel-like concierge services by Quintessentially Lifestyle.

Alcove loft to two-bedroom residences from \$2.25M to \$5.99M

Three-bedroom full floor residences from \$13.25M to \$18.75M

Four-bedroom duplex penthouse, \$65M

Model Residences
By Appointment Only

T: 212 913 9082
info@100E53.com
100E53.com

Artist renderings reflect the planned scale and interior design and are subject to the Sponsor's right to make changes to material specifications and design. Views shown are approximate and will vary depending on unit and floor. Not all residences contain the same material specifications, finishes and appliances. Please check with your sales representative. All dimensions are approximate and subject to construction variances. Plans, layouts and dimensions may contain minor variations from floor to floor. Sponsor, 610 Lexington Property LLC, reserves right to make changes in accordance with the terms of the Offering Plan. The complete offering terms are in an Offering Plan available from the Sponsor, File No. CD# 15-0075. We are pledged to the letter and the spirit of U.S. policy for the achievement of equal housing opportunity throughout the nation. We encourage and support an affirmative advertising and marketing program in which there are no barriers to obtaining housing because of race, color, religion, sex, handicap, familial status or national origin.

Readers respond to the 10.29.2017 issue.

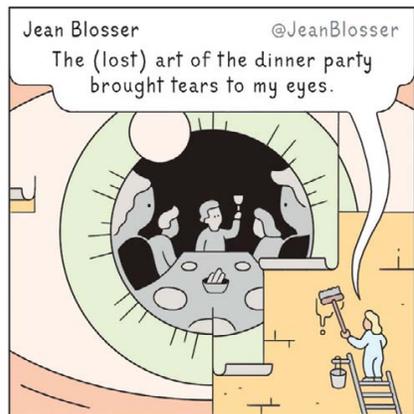
RE: DINNER PARTIES

Our food columnists — Dorie Greenspan, Gabrielle Hamilton, Samin Nosrat, Tejal Rao, Sam Sifton — wrote about the ageless charm of their dinner-party traditions, with stories from contributors on historical dinners, dinner-party flops and more.

My husband introduced me to The New York Times Magazine years ago when we were dating. It became a custom for him to open the sprawling paper and hand me the magazine. This past Saturday morning, he gave me the magazine with a gleeful look. “You are going to love this week’s issue.” And boy, was he right. Reading through “The Art of the Dinner Party” felt like unwrapping a special birthday present that a loved one had put hours of careful thought into making perfect just for me. I read multiple paragraphs out loud to my husband, each time saying, “O.K., sorry, this is the last one, but I have to read you one more part!” Gabrielle Hamilton’s piece “The Grown-Ups’ Table” was especially my favorite.

Hands down, I’ve never read something that resonated with me so strongly. Thank you so much for putting together this collection. I’m keeping this issue on the shelf with my treasured recipe books and am sure I’ll frequent it often.
Elise Baldenko, West Hartford, Conn.

The fantastic stories about historical dinner parties put into perspective how social interactions can really influence the course of history. We can all think, What if the butterfly didn’t flap its wings in a certain way over the east Atlantic and cause the disturbance that led to a hurricane? We have no control (unless we eradicate butterflies).



It is interesting to learn, through actual historical events such as these, how seemingly benign dinners can lead to, in some cases, unexpected extemporaneous results and in others a still-unexpected but desired result.

Phillip Tirman, Malibu, Calif.

I think this is one of the most important features in The Times in a while. Yes, the news is ever present, issues in the Koreas, the president and on and on. But the human connection is the reason we are placed here, and the art of joining together is something that is honed not only by the host but also by the guests. We’ve found, across many small and large gatherings in our home (and backyard) that it takes many comings together of a core group of people for them to start to feel truly comfortable and fall back into human communication and communion.
Zeno Franco, Milwaukee

Yes, yes to Gabrielle Hamilton, a thousand times over. Yes to knowing that I do all this because of that perfect, glorious moment after dinner with more wine and conversation — that’s the reason I endure the every-single-time-without-exception-moment hours earlier in the prep when I ask myself, “Why did I say I would do this?” Thank you too for understanding that there is an art to being a guest — do not ask “What can I do to help?” and do not worry that I am doing too much. Thank you for the lovely articulation of fleeting moments that make me go back to entertaining again and again.
Libby Egnor, Decatur, Ga., on nytimes.com

While I devoured last week’s dinner-party issue, I have to commend Gabrielle



THE COVER, ON TWITTER

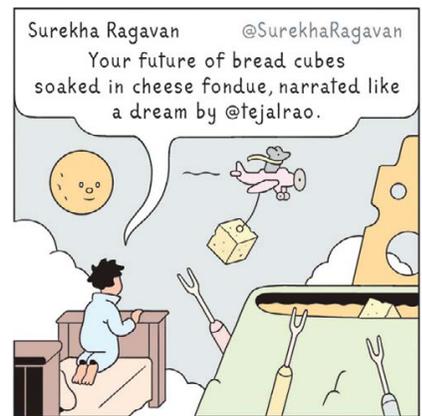
Almost a homage to Arcimboldo!
[@jfporchez](#)

Hamilton for her spot-on critique, and personal lamentation, of modern dinner parties in “The Grown-Ups’ Table.” Hamilton nails it: It’s not about the food; it’s about the people. The art of the dinner party is indeed in an age of crisis. Once a phone is produced, verbal storytelling comes to an abrupt halt, and eye contact is killed — no inconsequential side effect. A lifetime fan of long dinners, slow courses, table games and next-day cleanups, I align with Hamilton’s point of view on what this whole thing is about: the people, not (entirely) the food.

In our age of preciousness about food, it was truly refreshing to hear that a headliner foodie like Hamilton “gets it.” That without the wine and the bread and the stew, there would be no dinner party, but more important, that without the people and stories and the banter and the theater, there would be no “party” at all.

By the way, kudos as well to Marcus Nilsson, whose accompanying photo set the table, so to speak, and made me do a double take. Was that my table last Sunday morning?

Kari Niles, South Orange, N.J.



CORRECTIONS

An article on Oct. 29 about a dinner in 1908 honoring Henri Rousseau erroneously included a writer in the list of invitees to the event. Alfred Jarry was not invited; he died the previous year.

An article on Nov. 5 about Democrats and the 2018 midterm elections included an erroneous figure for the number of times a president’s party suffered no electoral losses midway into the president’s first term. It is two times, not three.

Send your thoughts to magazine@nytimes.com.

‘The art of joining together is something that is honed not only by the host but also by the guests.’



THE ACCELERATOR FOR STARTUPS REIMAGINING CITY LIFE.

Every six months URBAN-X invests in up to 10 companies defining the future of urban living. We help startups with the unique challenges of working with cities in sectors like mobility, real estate, energy, waste and water. We team our startups with MINI designers and engineers to develop city-sized solutions on a human scale.

#MAKEYOURCITY

URBAN-X

Built
by





Imagining a world of
autonomous cars.



is a truth as visible from space, in the tendrils of our brightly lit megahighways, as it is under a microscope, in the diesel particles that tar our lungs: America is a car country. This truth has been true for more than a hundred years now. Soon after the turn of the 20th century, the automobile became pervasive in urban centers, establishing a new, briskly perilous pace for city life; by the 1930s, as annual vehicle sales surpassed four million, urban streetcar systems had begun to go defunct, scrapped in favor of gas-burning buses; by the mid-1950s, new cars increasingly rolled off the line into a suburban way of life that the car itself had made possible. Suburbs had already swallowed a quarter of the population when, at the behest of President Dwight D. Eisenhower in 1956, Congress inaugurated the most ambitious infrastructure project in the nation's history: a 47,000-mile Interstate highway system. Its construction would crisscross the nation and spread even more suburbia as it went, bringing a profusion of new features to the American landscape — not just countless cloverleaves and imposingly stacked overpasses but drive-ins, drive-throughs, cul-de-sacs, acres upon acres of blacktop parking.

As the car transformed the American lifestyle, so did it colonize the American imagination. Perhaps the most fascinating artifact of automotive retrofuturism dates to 1958, two years into the Interstate building boom, when Disney produced an hourlong TV program called “Magic Highway, U.S.A.” After a half-hour or so celebrating the car's ascent, the program pivoted to envisioning its future. At a time when Eisenhower's Interstate project — inspired, famously, by his awe at traveling Hitler's autobahn during the Nazi overthrow — was seizing private property through eminent domain around the country, Disney imagined atomic-powered tunnel borers and imperial road-building machines as tall and wide as skyscrapers, cutting through landscapes and leaving fully constructed roadways in their wake. Dreaming further forward,

Over the next century, the self-driving car may well alter the built environment as radically as the manually driven car did over the last century.

the program extrapolated from the new real-world highways to envision literal high-ways of clear tubes raised far above the urban environment, magnificent air-conditioned arteries that someday



REFINED LUXURY INDUSTRIAL SPIRIT



91 LEONARD

— TRIBECA —

NEW STUDIO TO FOUR-BEDROOM CONDOMINIUM RESIDENCES
WITH EXCEPTIONAL AMENITIES
PRICED FROM \$795,000

SALES GALLERY: 75 LEONARD STREET, NEW YORK, NY 10013
212.981.8502 | 91LEONARD.COM



The complete offering terms are in an offering plan available from sponsor. File No. CD17-0129. Sponsor: 353-357 Broadway LLC, 75 Broad Street, Suite 2100, New York, New York 10004. Equal Housing Opportunity.



would “link together all nations and help create a better understanding among the peoples of the world.”

Some of Disney’s imagined future has indeed become our present, from rear-facing cameras to automated GPS-style directions. But the program’s writers and illustrators would no doubt have been shocked to learn that in 2017, nearly 60 years into the glorious automotive future, the physical highways we drive on would be functionally identical (probably inferior, in fact, after decades of neglect and disrepair) to those outside their office windows. Perhaps the most succinct explanation for why Disney did not get its future highways is that Eisenhower got his. The realization of the Interstate System wound up spanning three and a half decades and consuming hundreds of billions of dollars in construction costs, an unparalleled, concentrated investment of financial and political capital that ensured any new transportation innovations for decades would need to be designed to exploit it. Like so many sci-fi dreamers, Disney’s writers tried to think of the perfect transportation system, but in real life, the good-enough — the version of a technology that a society actually finds, in a concrete historical moment, the money and political will to enact — often winds up being the enemy of the perfect.

More perversely still, the suburban lifestyle that the Interstates enabled also gave rise to an atomized, individualistic politics, which soon bred a revolt against the taxation and central planning that made their construction possible in the first place. Disney’s writers saw a new infrastructural grandeur around them and imagined it would spark more grandeur, but in fact the highway boom proved to be a self-negating act of imagination, like one of those “useless machines” that sends out a mechanical hand to turn itself off.

Instead, as the dismal cycle of road-building and sprawl has continued, the last half century of automotive technology has brought mostly defensive advances — innovations that add no excitement to the car but merely ameliorate one or more of its truly terrible qualities. Airbags reduced its fatality rate, while federal emissions standards beat back smog. Hybrid and electric drivetrains have allowed some consumers to pay for the pleasure

It’s a set of basic human questions, far more than technology, that will really determine the future of the car. Such as: Can cars decouple from their history as a status symbol?

ematics of raising a ton of metal into the air, even if done electrically, are disastrous in a world where the plurality of electricity will be generated with fossil fuels for the foreseeable future. Sci-fi horizons thus foreclosed to them, automakers have poured much of their design energies into weird personalization features (the driver’s seat remembers who you are!) or better integration between stereos and smartphones (never miss a podcast!). After a century in which the car radically remapped American society, creativity about its own future got stuck in a cul-de-sac.

But now, the car has been steered once again toward a fantastical sci-fi destination. The dream of cars that drive themselves has been around almost as long as cars have — Americans saw a concept for some at the 1939 World’s Fair, and another, more far-fetched one in “Magic Highway, U.S.A.” — but the push to make it real began a little over a decade ago, powered by academic roboticists and funded by the U.S. military. In 2004, Darpa inaugurated its “Grand Challenge,” offering a \$1 million prize to an autonomous vehicle that could navigate a 142-mile course; no team’s robot was able to finish that first year, but the following year, five did, with first prize going to Stanford’s team. Google made the dream significantly more real beginning in 2009, when it began pouring hundreds of millions of dollars into the concept.

In the past five years, the headlong push toward self-driving technology has swept up not just Google’s tech rivals (chief among them Uber, with which Google has become embroiled in a bitter and costly intellectual-property

PURE MOBILITY



PlanetM is home to Mcity and the American Center for Mobility, North America's only real-world testing facilities that allow autonomous and connected vehicles to be researched and validated under all road and weather conditions. It's also where you'll find the largest deployment of Vehicle to Infrastructure (V2I) technology in the country. If you're looking to make advances in mobility, turn to a state investing in its future. Michigan. To learn how PlanetM can connect you with the right mobility resources in Michigan, visit planetmlandingzone.com

MICHIGAN ECONOMIC
DEVELOPMENT CORPORATION

PURE MICHIGAN®

planetm®



lawsuit) but the world's automakers as well. Tesla, Cadillac, Volvo, Audi and Nissan have already rolled out models with autonomous modes for highway driving, akin to cruise controls that can also steer and brake; next year, more brands and models will join their ranks. Most of the major automakers say they expect fully autonomous vehicles to be available 15 years from now, and quite a few of them are backing that prediction with enormous capital, from GM's \$1 billion acquisition of a self-driving start-up, Cruise Automation, to Ford's equally large investment in an A.I. start-up called Argo. Folly or not, self-driving cars are the future that nearly every major car company thinks it has to bet on.

For this installment of our annual Tech and Design Issue, we've devoted the entire magazine, front to back, to the question of autonomous cars and the future they could usher in. That level of attention seems warranted, given how profoundly this technology could change the way we live, with first- and second- and third-order effects that boggle the mind. We've visited with automakers in Detroit and in Silicon Valley to take the measure of their self-driving schemes. But we've also indulged in some sci-fi speculation of our own, trying to imagine what would happen if this unprecedented engine of American society — the machine that, more than any other, for better or worse, has given shape to American life for a century — really does undergo this radical transformation. The consequences would touch crime and punishment, work and leisure, exercise and partying and sex. Over the next century, they may well alter the built environment as radically as the manually driven car did over the last century.

As much as possible, we've tried to avoid the trap of extrapolating the future solely from the technology while assuming the society that we currently have. When the automobile came to cities a century ago, the norm was that pedestrians and carriages shared the streets equally, and it would have made sense to imagine that practice would continue. But soon the automotive interests grew powerful enough to seize the streets for themselves — resulting in the literal invention of a crime, called jaywalking — and then to displace

Perversely, the suburban lifestyle that the Interstates enabled also gave rise to an atomized, individualistic politics, which soon bred a revolt against the taxation and central planning that made them possible in the first place.

the arguably superior technology of streetcars. Likewise, self-driving cars will create new power centers, new crimes, just as they will create new counterpowers, new forms of rebellion. Die-hard drivers might not relinquish their steering wheels easily. Industries gored by self-driving technology (Who needs

motels if your car has a bed? What happens to gas stations when cars can drive themselves to charging ports?) might flex political muscle to check its progress. Law enforcement might stoke fears of autonomous getaway cars or self-driving terrorism to do the same.

Indeed, it's a set of basic human questions, far more than technology, that will really determine the future of the car. Can cars decouple from their history as a status symbol? Will millennial attitudes on car ownership entrench and deepen, to the point that car-sharing becomes a real cultural norm, or will that generation revert to the American mean as it ages? Will the push to kill the steering wheel look like a new freedom, to be met with excitement, or like a new prohibition, to be met with reactionary backlash? Will we muster the political will to push back on corporate power, as autonomous cars create new quasi-monopolistic giants? Or could autonomous cars actually arrive into a totally different economic and political order, one that they help to bring about? After all, Disney couldn't have foreseen, in 1958, the political realities of today that would make their imagined future impossible — realities that the highway itself helped create. The political and social convulsions of the next 50 years will be the real driver of our high-tech future. It's fun to guess at the ending of that unwritten history, but in truth we don't entirely know yet how it will begin. ♦

Bill Wasik is a deputy editor of the magazine.



Why did
she borrow
\$67,928
for tuition?

She did it to
work for you.

Now there's a job benefit
that helps your employees
pay off their student loans.

Gradifi is gratitude.



Learn more at gradifi.com or call 1-844-GRADIFI

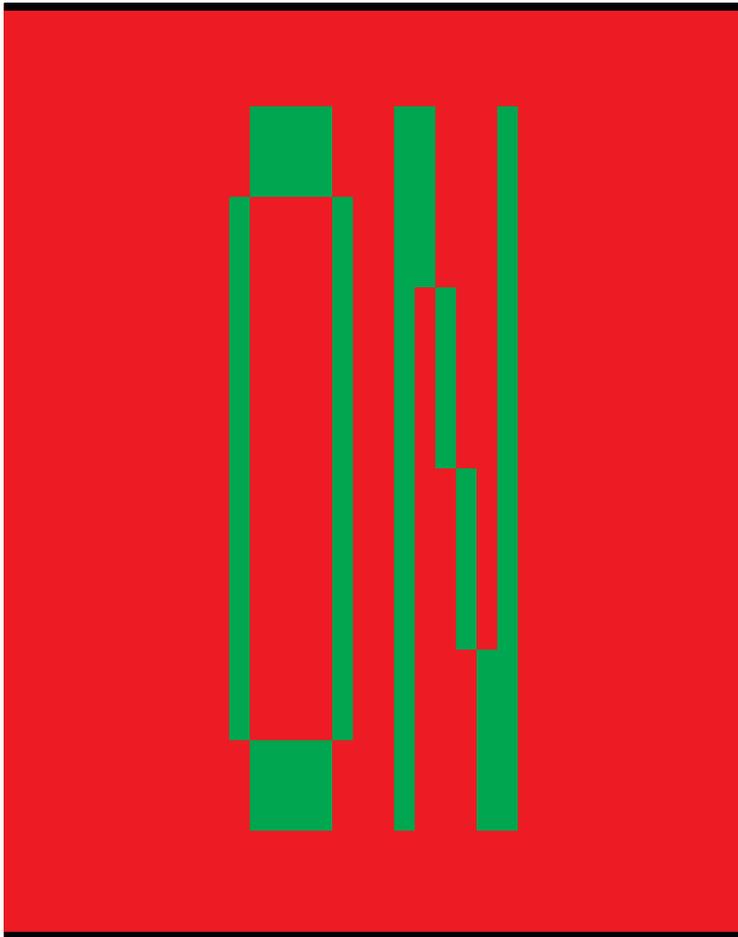


Can Ford, an emblem and engine of the 20th-century economy,
turn itself into a tech company? Its future depends on the answer.

BY KEVIN ROOSE PHOTOGRAPHS BY MARK PETERSON

HUSTLE





a sunny afternoon in early October, I drove across a parking lot in Ann Arbor, Mich., and down a sloping road to a second, private lot. A fence lining the lot's perimeter was covered in black fabric, as if to deter snoops. Behind it was a 32-acre Potemkin village. There were paved roads with names and signs: Liberty Street, Main Street, Wolverine Avenue. There was a traffic roundabout, a covered underpass and a railroad crossing. There were cosmetic props, too — newspaper boxes, sidewalk benches, a row of fake storefronts.

Mcicity, as the facility is known, was built by the University of Michigan as a testing ground for automakers, including Ford, which has been experimenting with self-driving cars here for about two years. I parked my rental and climbed into the back of a white Ford Fusion with four spinning Lidar sensors on the roof, each roughly the size of a water glass, and a rack of high-performance computers in the trunk. Next to me sat Randy Visintainer, Ford's director of autonomous vehicle development. Jakob Hoellerbauer, a young Ford engineer, took the driver's seat. Wayne Williams, a Ford research scientist, sat beside him in the passenger seat typing on a laptop. We put on our seatbelts, and Hoellerbauer hit the ignition and pulled into the road. A beep came from the dashboard, indicating that the car was ready to engage self-driving mode. Hoellerbauer pushed a button on the steering wheel and took his hands away.

"We are now autonomous," Williams announced.

The car glided along Main Street to a four-way stop, waited for another car (driven by a researcher) to clear the intersection, then made a gentle right turn. Autonomous cars are programmed to drive conservatively, and any time our Fusion sensed an approaching object — like a Ford employee, role-playing an oblivious pedestrian — it slowed down until it was sure the path was clear, then proceeded cautiously. It felt like being chauffeured by an elderly ghost.

Two minutes into the drive, the car pulled around a traffic circle and up to a blinking red light at an empty intersection. It stopped. A few seconds passed. Perhaps, I thought, it was just being characteristically risk-averse.

Then a few more seconds passed, and the engineers started to look nervous. Williams squinted at his laptop.

"So right now, we're not sure if the intersection is clear, so we're being very cautious," Williams said, speaking for the car. "It's expecting..." He trailed off and turned to Hoellerbauer. "Why don't you just overtake it?" Hoellerbauer grabbed the wheel and tapped the gas pedal, overriding the self-driving system and manually steering us through the intersection.

"We didn't see that happen this morning," Williams explained, by way of an apology. We took another lap around Mcicity, and when we reached the intersection again, the car did the exact same thing.

Self-driving cars raise the specter of horrific malfunctions — a code glitch that sends a car careering off a cliff, a remote hack that disables the brakes — but perfectly innocuous problems like the one we experienced will be far more common, and no less an impediment to road-readiness. There are dozens of autonomous vehicles being tested all over the world — 43 companies are testing 295 different self-driving vehicles in California alone — and not one of them has a clean record. A self-driving Uber vehicle zoomed through a red light in San Francisco last year. The sensors on cars used by Waymo, the self-driving-car division of Alphabet, Google's corporate parent, have struggled in heavy rain and snow. I've had half a dozen self-driving-car experiences in my life, including a white-knuckle trip down Manhattan's West Side Highway in a Tesla Model X whose owner had set it to "autopilot" mode, and I wouldn't describe any of them as relaxing.

How quickly these rides will improve depends on whom you ask. Silicon Valley futurists, in typically sanguine fashion, predict that we are months, not years, away from a Cambrian explosion of autonomous cars. Waymo has a pilot program for its self-driving vehicles already underway in Arizona and says it's "really close" to being fully operational. Lyft, which has partnered with a start-up called Drive.ai, is aiming to have a fleet of self-driving cars operating in the Bay Area by the end of the year. And Elon Musk, the founder of Tesla, which has offered semiautonomous features since 2015, has suggested that its cars could be fully autonomous as soon as 2019.

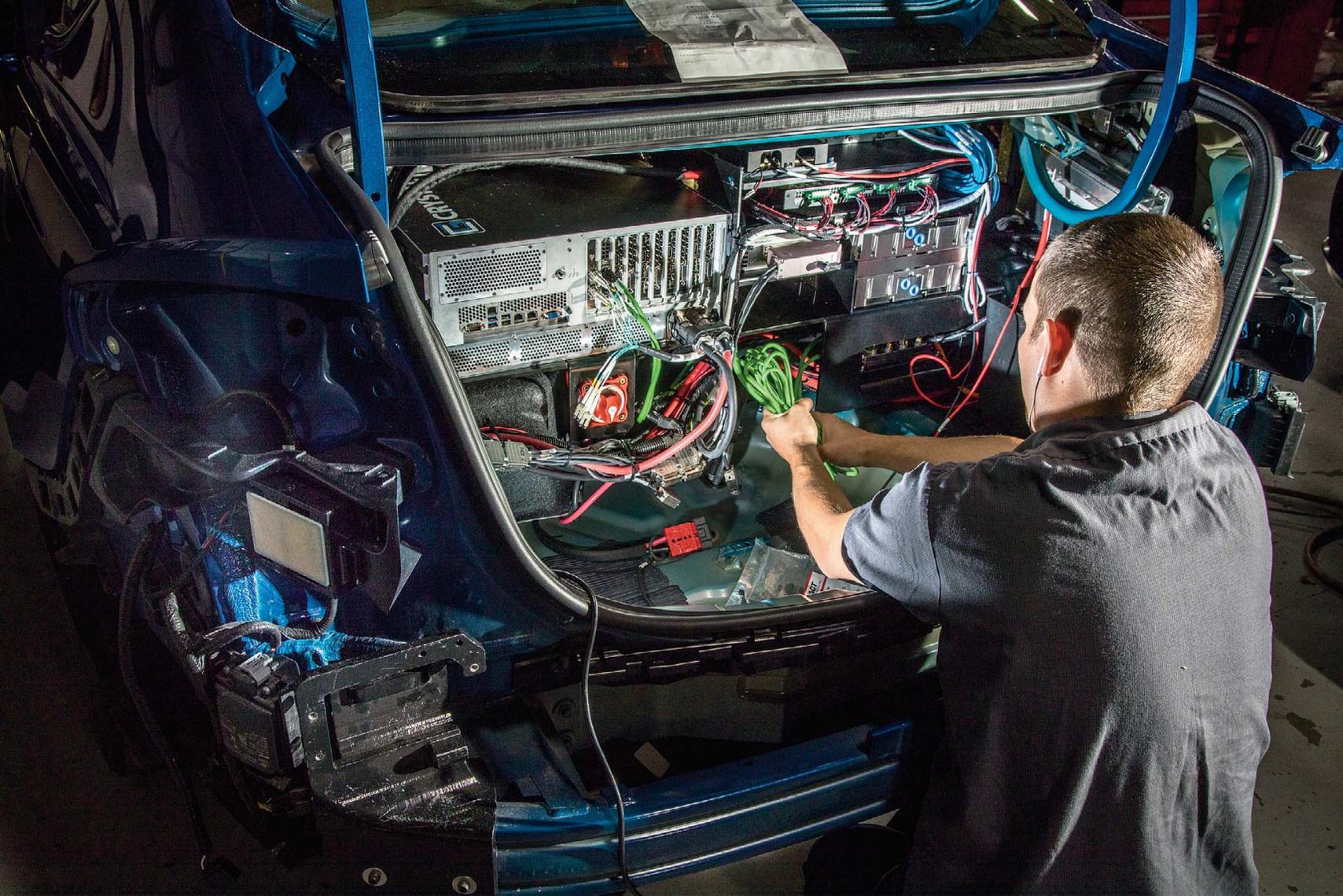
But that's California, where optimism is the coin of the realm. In Detroit, the timeline looks slower and more incremental. Ford, in particular, believes that the first generation of driverless cars will be limited, capable of traveling only in commercial fleets inside carefully plotted urban areas. Other cars will simply get smarter without being autonomous, with features like collision prevention

A worker at a Ford supplier conducting final checks of a self-driving Fusion test vehicle. Previous pages: Ford testing a self-driving car at Mcicity.

and self-parking becoming more common. Self-driving technology will eventually be more sophisticated and will one day be capable of full door-to-door autonomy in every possible area and condition, but as Ford sees it, that's not going to happen overnight, or even very soon.

Despite its pragmatic restraint, Ford has invested hundreds of millions in self-driving cars and is making surprising progress. In a report earlier this year, Navigant Research placed Ford at the top of its leader board, ahead of tech companies like Waymo and Uber as well as auto rivals like GM and Toyota, based on Ford's advanced manufacturing capabilities coupled with its strides in software development. The report generated headlines like, "Detroit Is Kicking Silicon Valley's Ass in the Race to Build Self-Driving Cars," and delivered a morale boost to Ford, which showed up late but finally felt as if it had a chance.

Ford's big, blinking target is 2021 — the year it hopes to release a vehicle that meets the Society of Automotive Engineers International's definition of Level 4 autonomy (no human operator required in the area and conditions it's programmed for). It's a tough deadline for a company whose culture might be the exact opposite of Silicon Valley's, where companies release half-finished "minimum viable products" and abide by maxims like "move fast and break things." Before Ford — or any conventional automaker — produces anything, each part has to pass a grueling battery of tests and certifications. There is a reason "automotive grade" has become



a synonym for “reliable.” “Our vehicles have to be a trusted product,” Chris Brewer, Ford’s chief engineer for autonomous vehicles, told me. “That is a little more important than ‘Did my phone freeze or not?’”

Americans are wary of driverless cars — 56 percent, according to the Pew Research Center, would prefer not to ride in one — and when I talked to Brewer, it occurred to me that some part of that hesitation might stem from who we assume will be producing them: Silicon Valley tech giants, the same stateless behemoths that have spent the last few decades barging into old-line industries like the Kool-Aid Man, destroying working-class jobs and leaving behind cold, modern efficiency. But maybe these skeptics could be persuaded to trust Detroit. After all, Brewer is right — self-driving cars aren’t smartphones. They’re two-ton projectiles that take your parents to the grocery store and your kids to soccer practice, that will need to make billions of computational decisions per second while moving at 65 miles per hour, that contain within them the power to extinguish human life. You kind of want them to take a while.

Leading Ford into this weird new era is Jim Hackett, who was named chief executive in May. Hackett, 62, is an oddity by Detroit standards. A design-minded aesthete in an industry dominated by gearheads and number crunchers, he spent two decades running Steelcase, a Michigan-based office-furniture company whose designers are often credited with — or blamed for — popularizing the open-plan office trend.

At a conference several years ago, Hackett struck up a conversation with Ford’s executive chairman, William Clay Ford Jr., who goes by Bill. He is the great-grandson of Henry Ford, and another auto-world misfit — an

outspoken environmentalist who once ruffled feathers at Ford by speaking at a Greenpeace event. The two bonded over their shared vision of “smart mobility,” a fuzzy term, more common among urbanists than businesspeople, for creating a sort of harmony among land use, technology and transportation of all forms. Hackett joined Ford’s board of directors in 2013. In 2016, Bill Ford persuaded Hackett to lead Ford’s newly created smart-mobility unit, and about a year later, he tapped him to run the entire company.

Hackett’s jockish C.V. — he played football at Michigan and briefly ran the school’s athletic department — masks his high-minded streak, which can make talking to him feel like taking a college philosophy seminar after a few bong rips. In the early 2000s, he began traveling to the Santa Fe Institute, a research group started by prominent scientists who wanted to study “complex adaptive systems” — a branch of theoretical physics that imagines the world as a series of complicated networks that are governed by universal laws and patterns, the same way biology is guided by Darwinian evolution. The rules that explained how anthills formed, they believed, might also explain urbanization trends in Southeast Asia or predict economic cycles. It was a formative experience for Hackett, who began to believe that businesses were governed by universal laws, too.

Hackett also became obsessed with “design thinking,” a new-agey management philosophy that has become trendy in recent years. Adherents believe that instead of optimizing for profit, organizations should put human emotion at the center of every strategy decision and begin by empathizing with their customers. “No technology ever evolves without the human interpreting and altering it,” Hackett says. “Every new

technology, the science and the engineering of it, has to give way to human understanding and use.”

Hackett is only six months into the chief-executive job, but his mannerisms have already entered Ford’s bloodstream. I arrived in Dearborn expecting to talk about drivetrains and crankshafts, but in a series of interviews with nearly a dozen executives, barely anyone mentioned cars or trucks at all. Instead, I heard the Ford Motor Company described as a “mobility solutions provider” that engages in “multimodal journey planning.” People spoke about “whiteboarding” and “blue-skying” big ideas. I watched a video that described Ford’s efforts to build a “holistic, organic, interconnected system powered by a transportation operating system.”

It is bizarre to watch an all-American manufacturing company get brain-snatched like this. Even the company’s new internal mission statement bears Hackett’s woolly imprint: “To become the world’s most trusted mobility company by designing smart vehicles for a smart world.” It’s not exactly “Built Ford Tough.” But it’s very much in keeping with Hackett’s worldview, in which everything exists in connection with everything else, and changing one piece of a system necessarily changes the whole. A car learns to drive itself, and a city’s transportation grid shifts around it.

This kind of big-picture futurism is necessary in Detroit today, where automakers are frantically reinventing themselves to stay ahead of

Argo AI’s self-driving test vehicles at its facility in Dearborn, Mich.



what they fear might be coming. The average personal vehicle is driven less than an hour per day. But self-driving cars can, in theory, pick up and drop off passengers all day, which significantly reduces the number of cars a community needs. (Researchers at the University of Michigan estimate that autonomous vehicles could cause car ownership to drop by as much as 43 percent. Lyft, which has a horse in the race, cites research estimating that as many as 80 percent of cars could eventually be eliminated.) And because much of the value of self-driving cars lies in the software that runs them, companies that make only hardware — known in the business as “original equipment manufacturers,” or O.E.M.s — are likely to be squeezed, or worse.

Faced with visions of a bleak future as low-margin widget-builders for Silicon Valley, automakers have spent the past several years trying to catch up. General Motors spent \$581 million to buy Cruise Automation, a self-driving-technology start-up. Fiat Chrysler Automobiles struck a deal with Waymo, in addition to partnering with BMW and Intel. Daimler and Volvo each joined with Uber, and Toyota set up a whole research institute in Silicon Valley to build its own self-driving vehicles.

Ford’s plans might be the most ambitious. It wants to have a hand in every part of the self-driving-car industry, including the software that replaces the human driver, the platform that connects and controls the cars and the services that spring up around them. To that end, Ford has spent the past several years quietly snapping up tech talent. It struck a partnership with Lyft and acquired Chariot, a San Francisco-based start-up that runs group shuttles for commuters. It set up an office in Palo Alto that now has 205 employees and created Greenfield Labs, a business incubator. It invested in Argo AI, a Pittsburgh-based artificial-intelligence start-up, and several other companies, including Velodyne, which makes Lidar sensors, and a connected-car software outfit called Autonomic.

Most industry observers believe these are the right moves for Ford to be making. But it’s still tough to reconcile today’s Ford — which makes money by selling millions of combustion-engine trucks and S.U.V.s every year, along with a handful of sedans and hybrids — with the eco-tech-mobility conglomerate Hackett envisions it becoming. One lesson Hackett learned from his studies is that in order to stay competitive, businesses often have to give up the things that made them great in the first place. (He calls this the “perversity law.”) I asked him if this meant that Ford would need to stop manufacturing conventional, gas-powered vehicles to survive.

“Well, part of that statement might be right,” he said. “Right now, that doesn’t make sense.” He clarified, sort of: “I’m really just trying to say the better form of problem solving is to abstract the problems.”

So let’s try abstracting Ford’s problems, to see how they might be solved. First: Ford was born at the beginning of a now-outmoded era of industrial production, one that it arguably ushered in. Back then, companies like Ford simply manufactured goods, and customers bought them. Those transactions represented a change of ownership — a customer who bought a car from Ford was free to install 15-inch subwoofers in it, or paint it bright yellow, or use it in a demolition derby — and they were typically one-time sales. Ford’s responsibility for the car, and its opportunity to make a profit, ended the minute the warranty ran out.

The internet changed that, by allowing companies to wrap physical goods in digital services that can be sold again and again, at much higher margins. Instead of selling servers to corporate I.T. departments, Amazon sells them time shares on a centralized server farm; instead of buying pricey home solar panels, customers can lease them from a solar service, paying for only the power they use. Makers of thermostats, baby monitors and other household gadgets “extend the value chain” by charging customers a monthly fee for information about their home energy use or their babies’ sleep patterns. Even the language these new enterprises use is different. Goods-based businesses spoke in terms of revenues and profits. Service-based businesses count metrics like



suspenders[®]

Dramatically powerful in its message of utility and simplicity, Suspenders is a delicately scaled, modular system of interconnected elements and suspended LED luminaires. Configured as individual lighting sculptures or as a tiered web of infinite scope and variety, Suspenders components offer a broad range of decorative and functional applications.

Explore the possibilities at:

www.sonnemanawayoflight.com.

www.sonnemanawayoflight.com
Multiple U.S. and foreign patents granted and pending.

SONNEMAN[®]
A WAY OF LIGHT

“churn,” “average revenue per user” and “lifetime value” — the total amount of money they can wring from a customer.

This phenomenon — which is sometimes referred to as “everything as a service,” abbreviated as XaaS and pronounced “zass,” among the kinds of people who say these things out loud — has quietly reshaped the entire economy. Trucking companies that once bought Michelin tires now rent them through a pay-per-mile service. Airlines that buy \$15 million jet engines from General Electric can subscribe to OnPoint, a “power by the hour” program that includes maintenance costs and data-analysis tools. G.E. Aviation now makes the better part of its revenue from services like these.

The auto industry was slow to come to grips with this new model — in part because it long ago gave away the entire service piece of its business to gas stations, body shops, Jiffy Lubes and a hundred other barnacle industries. Thanks to old and byzantine state laws, most carmakers aren’t even allowed to sell or lease directly to their customers

Collaboration takes many forms, of course, and not all tech companies seem interested in an equal partnership. John Krafcik, the chief executive of Waymo, told me that while traditional auto companies “bring a lot to the party” in terms of hardware expertise, they’re not well equipped to solve the software-based problem of replacing a human driver, which requires huge teams of highly skilled engineers and tremendous amounts of technological infrastructure — the kinds of tools available to only a Google sibling company. “The self-driving aspect is really supercomplicated,” Krafcik said. “We’ve spent the last nine years trying to solve that puzzle. It requires a lot of skills.” It also requires focus, which is a problem for companies that still sell millions of conventional cars and trucks a year, that have thousands of employees to pay and quarterly results to deliver, that can’t exactly drop everything and become software companies.

In Detroit, cautious optimism prevails. But outside Detroit, there are real doubts that any auto company can transform itself quickly enough.

“Autonomous vehicles are not an incremental shift,” said Carol Reiley, a founder of Drive.ai. “It’s a very transformative shift, almost like moving from the horse and carriage to the car.” Like many tech executives, Reiley saw Detroit’s quest to control the self-driving-car industry as tactically sound but ultimately a long shot. “I don’t know if they can make it,” she said. “There’s a lot of baggage.”

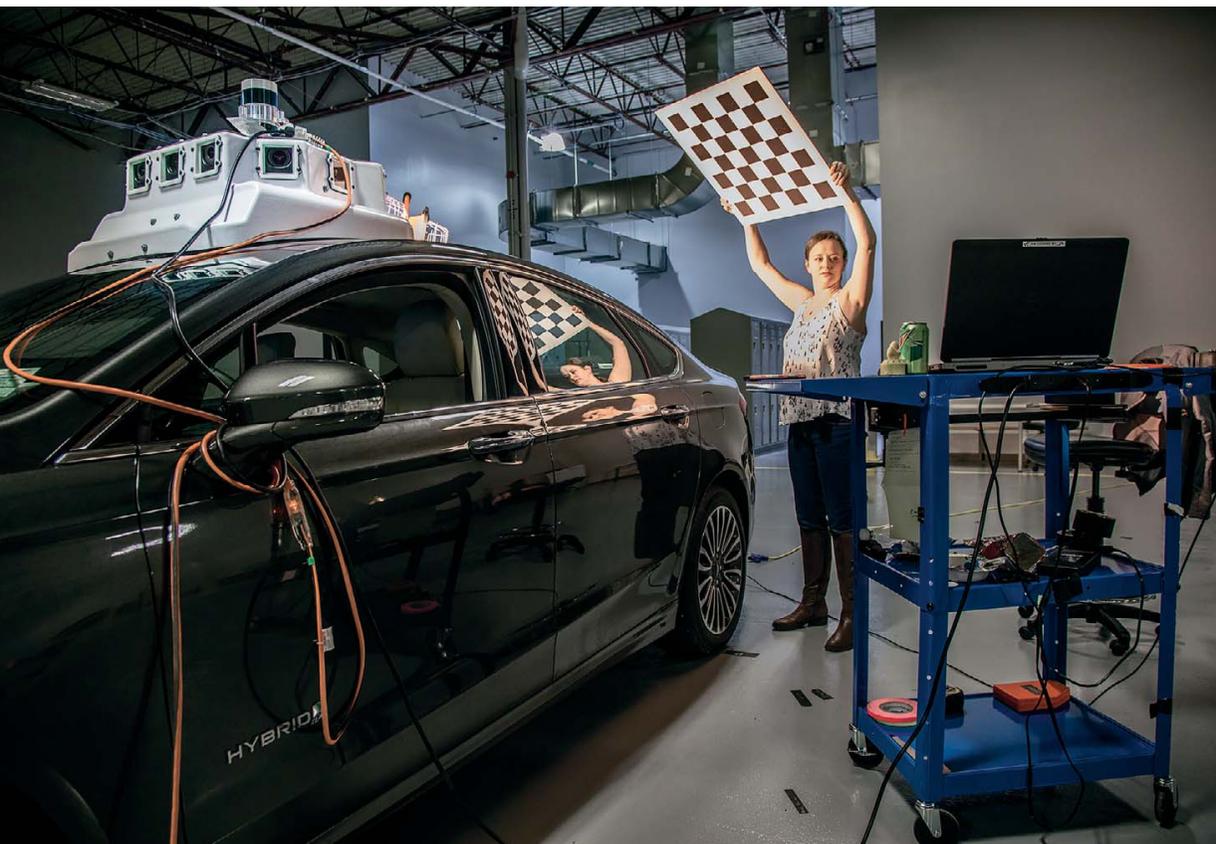
A week after my Detroit trip, I visited the Pittsburgh offices of Argo AI, the artificial-intelligence start-up that is creating the software brains for Ford’s self-driving vehicles. Ford is investing \$1 billion for a majority stake and controls two of Argo’s five board seats. Which means that Argo is an independent company, but only barely — 40 of its 230 employees are transfers from Ford, and Ford is its only corporate partner.

Argo’s headquarters is in Pittsburgh’s Strip District, a formerly industrial area just outside downtown that has become a center of driverless-car activity. (Uber’s Advanced Technologies Group is down the street.) Its office is a high-ceilinged space in a modern office building with conference

rooms named for famous scientists: Planck, Descartes, Hopper. When I arrived, engineers were eating catered lunch at their standing desks. Squint and ignore the smokestacks outside, and you could be in San Francisco — which is sort of the point. Ford wants Argo to look and feel like a nimble tech start-up, not a subsidiary of a century-old auto company.

I was greeted by Bryan Salesky and Peter Rander, Argo AI’s founders, both well-known figures in the small self-driving-car world. They had been special-faculty members at Carnegie Mellon’s prestigious robotics-engineering program, and Salesky competed in the 2007 Darpa Urban Challenge, a storied self-driving-vehicle race whose alumni now populate the top ranks of the autonomous-vehicle industry. Salesky went to Google to build self-driving cars; Rander went to Uber. They

(Continued on Page 76)



An Argo AI employee calibrating the sensors on a Ford Fusion test vehicle.

— every transaction has to go through an independent dealer. When it comes to data, automakers are flying blind. As Reilly P. Brennan, a venture capitalist who invests in self-driving technology, put it to me: “The urinal in the men’s bathroom knows more about its users than most carmakers in 2017.”

With self-driving cars, automakers see a chance to fix that. Ford’s executives talk hopefully about one day offering their own suite of software inside their autonomous vehicles, and building interfaces that companies like Netflix and Skype could plug into. They don’t see themselves usurping Silicon Valley, exactly, but they do see themselves playing in the same league. “Two to three years ago, the tech community was holding the auto industry at arm’s length,” said Ken Washington, Ford’s chief technology officer. “They thought we were sort of this curious industry that they could come into and disrupt.” He went on: “Now, when I go to Silicon Valley and I interact with tech companies, it’s a dynamic of much more intense interest in collaborating with us.”

*Your kids share
your last name.*

*Not your business
interests.*

We know, because we know you well.

Knowing our clients well gives us the insight to help with their wealth—and their lives. Business transitions between generations can take unexpected turns, which is why we offer solutions to meet the goals of all individuals involved. Find out how strong relationships lead to 95% client satisfaction.



BNY MELLON
WEALTH MANAGEMENT

877-452-7079 | bnymellonwealth.com | [@BNYMellonWealth](https://twitter.com/BNYMellonWealth)

What would happen if 20% of cars were autonomous? Life on the road would get amazing — and awkward.

Technically speaking, self-driving cars are already here. But in even the most optimistic scenario — given their persistent difficulties with situations as simple as a snowy day — robot drivers will remain wildly outnumbered by human drivers for the foreseeable future. Autonomous cars can't change the world until they're a major presence on the road.

Call it 20 percent: the day, if it ever arrives, that one out of five vehicles you encounter will be driving itself. In some ways, the 20 percent era is harder to imagine than the fully automated era, because this supposedly unstoppable and frictionless technology will still be embroiled in a total mess. The best, safest models will most likely come with the highest price tags, out of reach for those with average incomes. Coexistence between human and robot drivers will be uneasy at best; road rage against the machine will boil over. One catastrophic accident could still imperil the whole experiment, no matter what the overall statistics show.

But that inevitable mess is precisely what makes the one-in-five future so interesting to ponder. It's the first point, give or take, when it will be clear that a true self-driving future is even possible. When car companies will actually be able to rip out the steering wheels from some models, designing them in entirely different ways. When big trucking firms and car services like Uber will have begun to remove drivers from their vehicles. When hypercommuters will trust their cars to drive them three hours to the office while they sleep. When you might risk putting your child in one, alone.

The



A License To Ride?

BY TOM VANDERBILT

In 2008, I rode in a Stanford University VW Passat called Junior on a closed course in New York. Like a lot of beginners, it moved haltingly, with great caution; its minders in the front seats kept a close watch. But the moment felt transformative.

Driving, burned since adolescence into my muscle memory and sensory apparatus, was being executed without my (or any human) involvement. I felt like a ghost in the machine.

The autonomous vehicle went from test-track prototype to showroom reality far faster than I envisioned, propelled as much by advances in sensors and A.I. as by a collective hype cycle that seemed intent on willing these devices into existence, whether society was ready for them or not. Sitting with that “beginner” driver in 2008, as engineers closely observed its movements, took me back to that life-defining moment of getting a driver’s license. In my wallet, sparse with a library card and a school-lunch ticket, the license had real heft. It represented a primordial entry point to adulthood, a vast expansion of social possibility.

As a rite, the driver’s exam — I have failed it in two countries — is a ritual by turns (three-point, of course!) tedious and terrifying. If you can summon nothing else of the 1988 teen comedy “License to Drive,” you can still see James Avery’s gleefully malevolent D.M.V. examiner, wielding his famous coffee cup. Once autonomous technology begins to really take off, will the driver’s license, and the pedagogy behind it, go the way of the stick shift? Will the ability to drive begin to seem some exotic, rarely necessary skill — like starting a fire with a flint?

After all, in a vehicle that meets the Level 5 automation criteria of SAE International — “full-time performance by an Automated Driving System for all aspects of the dynamic driving task under all roadway and environmental conditions” — there would seem to be little point in

possessing this vestigial skill. We don’t require people entering elevators, riding in airport trams or letting Roombas loose upon their living rooms to be able to take over operation in case of machine failure; it’s hard to see why our interaction with this automated technology should be any different. Our learning process could be as quick and dirty as it is with other high-tech products: Toss out the instruction manual and watch someone do it on YouTube.

But this possibility, driver made passenger, broaches new territory in jurisprudence. With no licenses, what is the legal basis for restricting anyone — tweens, the elderly — from being ferried about? Young farm kids’ driving the family truck seems as obsolete as tail fins, but what’s stopping kids from being driven? Could children, often more adept at handling the smartphones of their parents than their owners are, have an advantage on older drivers less accustomed to technology? Yet the same fears that keep parents from letting their children walk to school may prevail over the allure of their autonomous vehicle handling the school run. It seems hard to say whether autonomous vehicles would hasten or delay the passage to adulthood.

And as drivers interact with semi-autonomous vehicles in the long run-up to Level 5, driver education and licensing, far from becoming obsolete, may become more important, argues John D. Lee, a professor of engineering at the University of Wisconsin-Madison. “Automation has a strong tendency to surprise people with unexpected behavior,” he says. Knowing what your car is doing — and when to take over — could be more vital than merely knowing how to drive. That water on the road — is it a surface puddle, or a veritable lake filling a gigantic pothole? That truck ahead with the dangerously swaying load — do you speed up to pass it? Is the pedestrian by the marked crosswalk waiting for you to yield or simply checking his iPhone? “Driving and managing the automation that is helping you drive,” Lee says, “are two quite different skill sets. Automation-management skills need to be learned as much as driving skills.”

Tom Vanderbilt is the author of “You May Also Like” and “Traffic.”

Empty-Car Surfing

BY ROLLO ROMIG



Driverless cars will sometimes need to move around the city with no humans in them at all — en route to pickups or drop-offs. As empty moving vehicles become a common sight, they're sure to enable an annoying off-label use: a flowering youth subculture of external joy riding, similar to subway surfing.

All over the country, bored teenagers will lurk on the roadside, waiting to leap onto the roofs of empty cars, hanging on for as long as they can. The surfers will take advantage of advances in cloaking technology to help them confuse the cars' sensors. Some will develop a clever assortment of grips and attachments to help them stay on, although the best among them will sneer at those who need to use tools. Fatalities will be inevitable, and often gruesome.

To keep the kids off, car owners will try to coat their cars in slick repellents; these will be effective but too messy to be practical. Soon, dealers of autonomous cars will offer optional rows of spikes similar to those we already use to keep homeless people off benches. Once again, design will become more hostile in the name of safety.

Rollo Romig is a journalist based in New York.



In-Vehicle Leisure

BY JAMES SOMERS

Just two months ago, the House unanimously passed a bill that would allow self-driving cars to be largely exempted from the safety standards that for decades have constrained the design of automotive interiors. There are only so many places you can bolt seatbelts to the car's frame, after all. But once autonomous



technology matures, some models will be made so much roomier that they will become *rooms*. A high clearance and thin frames will mean getting in without bending down. All the impedimenta of front seats — the jutting dash, the steering wheel and pedals, the high center console with a stick — can fold away. You'll be able to swivel in your chair like a captain in "Star Trek."

Liberated from having to watch the road, commuters' eyes will be free to — what else? — consume video content. Sound's hold on drive time — first with terrestrial radio, then satellite radio, then podcasts — will give way to sight. But what kind of videos will we watch? If Marchetti's constant holds (this is the idea that as transportation technology and urban planning change, people contort their lives to keep their commutes to an average of one hour per day), they will be not feature

films but TV shows and short videos of the kind being increasingly produced for Facebook and YouTube. Podcasts will be displaced by vodcasts. Media companies are already negotiating with carmakers about how to price their offerings. Should in-car entertainment work more like cable or like the on-demand system in a hotel? Like Netflix or like Roku?

Most riders who play games will use their phones. But by the time one in five cars is autonomous, console makers will develop specific products for it. The nearly two hours a day of console gaming played by some 60 million Americans will tick up accordingly. Swarms of commuters hitting the morning and evening roads in waves will become swarms of druids or mercenaries in massively multiplayer online games, some of which might come to incorporate the driving experience itself, a Pokémon Go for the highway.

It seems less likely that we'll use this opportunity to steal time back from screens. But if there's enough space for a table, maybe commuters will sit around it playing poker or telling stories. Cars are, indeed, the most private places we have, sealed shut, out of earshot. (The writer Nicholson Baker has said that he likes to write while in a car parked in a shady spot.)

Chris Anderson — formerly the editor of *Wired*, now the head of a drone-data company and, in his spare time, of a racing league for autonomous cars — says the question of what we'll do inside self-driving cars always comes up at cocktail parties. It always confounds him. “We *have* this world,” he says. “It’s called the back seat of an Uber.” We already know what passengers do in back seats, be they in a limo or an R.V. or a tour bus: They pull out their phones or their iPads, or they talk to one another, or they take a nap. Why should we think that not having a driver will change anything?

In an essay for *Real Life* magazine titled “Perpetual Motion Machines,” Chenoe Hart argues that we miss something when we think of autonomous cars this way, as a difference in degree, not in kind. Because we won’t have to worry about driving, vehicle interiors can expand to a point where we stop thinking of them as vehicles: They might have fully functional kitchens, or gyms, or beds. Instead of going to the coffee shop, the coffee shop might come to you; instead of going into the garage to pull out your car, the garage will *be* the car. The ability to summon spaces like this, Hart writes, will turn the built environment into a kind of random-access memory — with every destination equally accessible from anywhere. Whether it drove to you or you to it will be irrelevant; motion will be so smooth and constant as to be imperceptible. Hart argues that when travel becomes fully autonomous, we will always be traveling: families or co-workers in quiet concert on giant roads, moving in a cluster of moving buildings, chasing good weather, hardly aware that we’re going anywhere at all.

James Somers is a writer and programmer based in New York.

The Autonomous-Car Workout

BY GRETCHEN REYNOLDS



Dashboard resistance straps would allow mid-ride rowing.



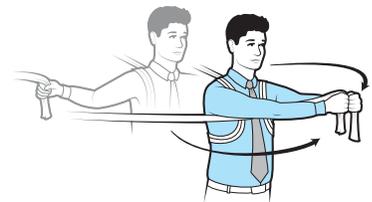
Ceiling straps would enable a classic pull-down exercise.



A harness could allow squats on a balance ball.



Interiors could include exercise bikes with harness clips.



This upper-body chest fly would require straps anchored to the windows and doors.

There’s never enough time in the day to exercise, but perhaps the solution is in our cars. “A self-driving vehicle could definitely make a great gym, because it’s rigid all over,” says Marko Vujicic, an engineer and a partner at NPD Team, a company that consults with exercise-equipment manufacturers about machine designs. “That rigidity theoretically allows you to use every plane of the car against which to apply resistance. Your car becomes a full weight room on wheels.”

It’s not as straightforward as it sounds. For one thing, the vehicles would not be freed from the laws

of physics. Should your car abruptly brake while you were, for example, running on a treadmill, the treadmill would cease moving forward — but you wouldn’t, at least until you hit a windshield or door.

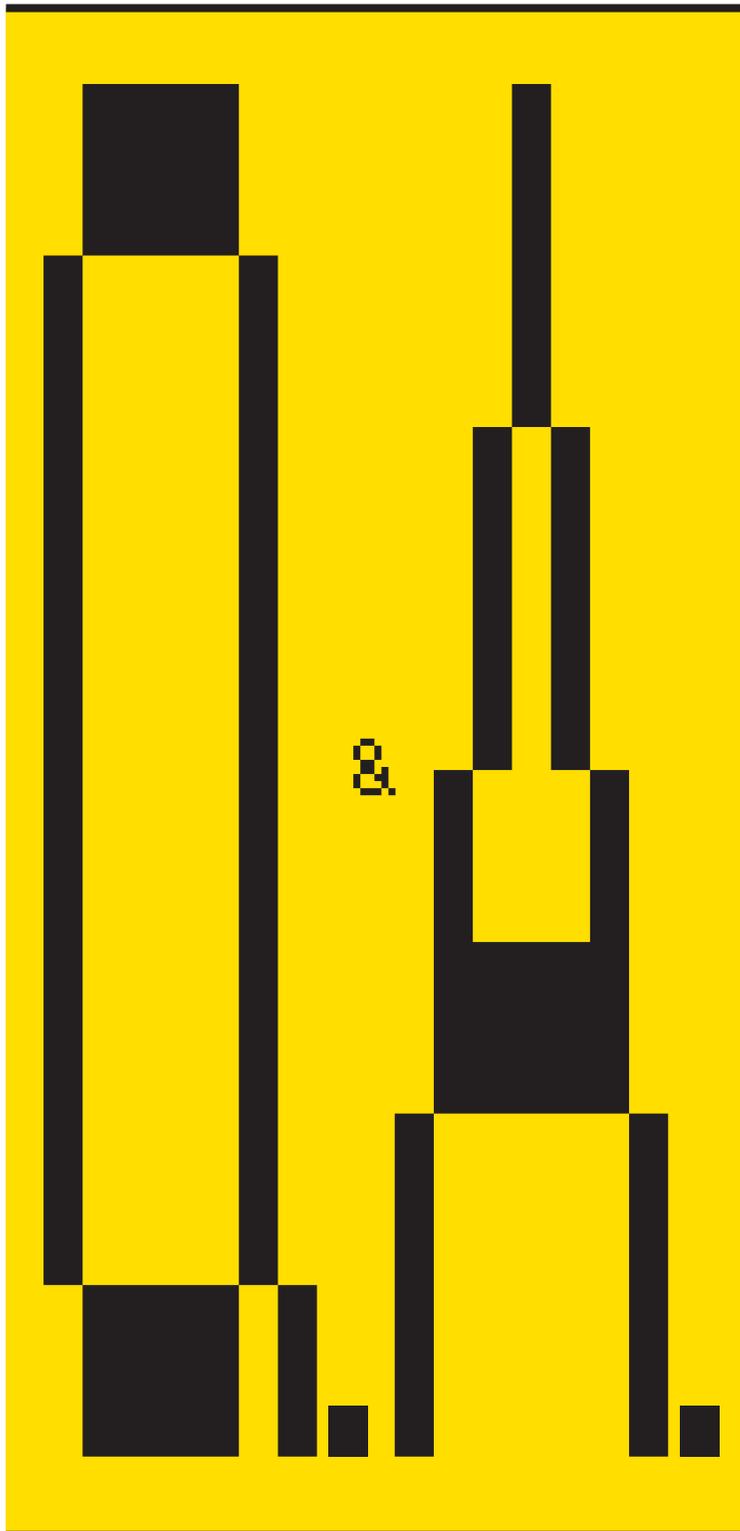
It might be easier to remain seated. “The car could have special pockets all over the place that hold resistance bands of different strengths,” says Bryant Johnson, a personal trainer and the author of “The Ruth Bader Ginsburg Workout.” “You could use those to get a full-body strength-training workout.”

Throughout your commute, your future car could scrutinize your efforts, says Steve McCauley, the

head of health services for the Wynn Las Vegas resort, with fingertip monitors or other sensors tracking your heart rate and the composition of your sweat.

But realistically, many of us will use our salvaged commuting time otherwise. In tomorrow’s cars, the area beneath the hood may not be needed for a combustion engine, Vujicic says — but it will remain, for reasons of mechanical stability and safety. Fitted with some padding and a safety belt, it becomes a napping cave.

Gretchen Reynolds is the Well columnist for the magazine.



Learning From Singapore:

Limin Hee

INTERVIEW BY JENNA WORTHAM

If self-driving cars start to make up a significant portion of urban traffic, they're likely to push cities to become more populous and compact, with fewer owned vehicles and more car sharing. The future, that is, would look more like Singapore, one of the world's densest cities, whose government in recent years has tried to curb car ownership and ease congestion problems. We reached out to Limin Hee, the director of research at Singapore's Center for Livable Cities, to ask her about how she thinks autonomous cars will begin to change urban life.

Tell me about Singapore's approach to self-driving cars. The idea of autonomous vehicles is one measure we're looking at to see a reduction in private car ownership. According to research done with M.I.T., we would only need about a third of the current vehicle population to provide mobility on demand. We find that a lot of private cars spend most of their time in parking lots. The land we use for parking could be used for other purposes. We are a very dense city, and we have been trying to plan our households around concentration of people. By 2030, we anticipate that eight out of 10 households will be within a 10-minute walk of a rapid-transit station.

What about people who don't live in a dense urban environment? Eighty percent of our population lives in high-rise housing. So we can safely say the majority live in dense conditions.

How else do you see autonomous cars being used? Another possible use for them is trash collection and road sweeping. They don't have to operate during people's working hours. They can work in the dead of night, which helps us with congestion problems.

What are the other motivating factors? We also have to reduce our reliance on manpower. It's been increasingly difficult to recruit truck drivers and bus drivers in Singapore from our local population. We're also trying to reduce our reliance on foreign labor.

How will the technology transform the city? We are not so excited about the technology itself, as far as people owning self-driving cars. We are more focused on using autonomous vehicles as an urban infrastructure — a shared system that could allow the kind of accessibility that people have come to expect from their own cars. They could be as convenient as private cars, but at a much more affordable price point, and without adding to congestion and pollution.

How might the shift reshape the work-life balance? Our whole relationship to commuting will change. It's very appealing to our millennial generation, who are constantly on their phones and screens, and it will free people from focusing on driving. They can email and go on social media or read a book.

You've talked a lot about the upsides. Are there any potential downsides that you're preparing for? There are people who rely on being drivers as their jobs, but this is part of a greater technological disruption. There will be ways of either retraining or reskilling people whose jobs depend on driving to keep them gainfully employed. And if we have larger fleets of driverless cars, there will be more jobs to maintain these vehicles and keep them up to speed.

Will it be affordable? The price of public transportation is regulated and managed, but we do want to offer people a range of options, including trains and car-sharing, so people can pick the option at the price point that works for them.

In some cities in the United States, public transit has made segregation and social inequality worse: For example, certain train stops and bus lines don't run from lower-income areas to wealthier ones. Is it possible that driverless cars will cause similar discrepancies?

We actually think this will make Singapore more equitable as we try to move away from private cars, which worsen the divide between the haves and have-nots.

Jenna Wortham is a staff writer for the magazine.

We're all used to the way security is:
Control panels, contracts,
passcodes and paranoia.

Lots of hurry hurry, quick quick.

But what if security were different?

What if it felt like
it was one step ahead?

With the answers to
"What was that?" and
"Who is that?" just like that.

What if it were tough on
bad guys, easy on you?

What if it were so simple to use,
you actually used it?



Nest Guard



Nest Tag



Nest Detect



Nest Cam IQ indoor



Nest Cam IQ outdoor



Nest Hello video doorbell

nest

From now on, this is security.



Hackers' Delight

BY YIREN LU

The ongoing transformation of cars — from mechanical systems of gears and switches into computers with dreams of self-determination — has been accompanied, perhaps predictably, by a parallel evolution in security threats. A decade ago, hacking a car relied on physically tapping into its internal network, for instance through a port sometimes found behind the radio. By 2011, it was possible to do the same thing remotely. In a series of demonstrations using internet-enabled navigation and entertainment systems as

ways to hack into a Jeep Cherokee, Charlie Miller and Chris Valasek — both of whom later worked on self-driving security issues at companies like Uber, Didi Chuxing and Cruise — turned on its windshield wipers, disengaged the transmission and disabled the brakes, all from 10 miles away.

These exploits, though dramatic, took advantage of the same vulnerabilities in cellular networks that might plague any tablet or smart vacuum cleaner. But a future in which one in five vehicles is autonomous will not only increase the attack “surface” (in the metaphor favored by researchers) of the car; it will also force manufacturers to confront more insidious security risks that are only now coming into view. It will become possible to compromise vehicles by hacking the *environment*.

A car that drives itself uses sensors to construct high-resolution images of its surroundings, then runs them through a “classifier” to identify all the objects in the image. The classifier can do this because it has trained on labeled images; after seeing a hundred thousand trucks, it learns to recognize certain features

as indicating truck-ness. Today’s most popular and effective classifiers for object recognition, used widely in self-driving car software, are called deep neural networks.

But a deep neural network offers researchers very little understanding of *why* objects become classified as they do. Think of its output as a map, with each classification corresponding, like a ZIP code, to some demarcated region. Insead of existing in just two dimensions, though, the map has more like a thousand dimensions — and the slightest move in any one of these dimensions can push us into a different ZIP code and produce a false classification. This makes it possible for a hacker to construct slightly perturbed images, called “adversarial examples,” that look innocuous to the human eye but fool the car’s brain into making the wrong call, with potentially fatal consequences.

Adversarial examples are extremely difficult to defend against. “We don’t understand these attacks,” says Dawn Song, a professor of computer science at the University of California, Berkeley. “But the deeper question is that we

don’t understand deep neural networks.” In a recent paper, Song and her co-authors introduced a method of constructing robust adversarial examples that can even be printed on paper and pasted to road signs. A stop sign defaced with specially calibrated graffiti, for instance, is recognized as a 45 m.p.h. speed-limit sign.

Song’s warning extends beyond road infrastructure. While researchers for decades have been working on — and developing countermeasures for — software vulnerabilities, the study of security issues related to deep learning is still in its infancy. “We don’t have a precise mathematical definition of a pedestrian,” Song says. “There’s no way for us to write down a formula describing exactly what a pedestrian is. So we can’t even really define our security goals.” Even with a recent surge of interest in adversarial examples, researchers are still struggling to understand the scope of the problem. Given the physical-world ramifications, Song says, “we should have started even sooner.”

Yiren Lu is a writer and software engineer in New York.

From now on, security is easy to live with.



Nest Guard



Nest Tag



Nest Detect

With the Nest Secure alarm system, you can come and go without rushing in and out the door. Arm and disarm without a passcode. And open a door or window without worrying about setting off the alarm.

nest

From now on, this is security.

The Liability Conundrum

BY NATHANIEL POPPER



If you think the aftermath of car crashes is complicated now — the arguments over fault, over repair costs, over whose insurance policy will pay — wait until self-driving cars are sharing the roads with human drivers. Start with all those delicate and expensive parts that communicate with a car's software in order to make its autonomy possible. A fender-bender involving a Tesla means an expensive fender needs to be paid for; a part full of sensors and cameras costs a lot more to replace than a hunk of plastic on the back of an old Camry. In fact, some car insurers, like one AAA affiliate, have already said they would charge more to insure certain Tesla models. Tesla has countered with a campaign to convince insurers that its cars will be in fewer crashes; the company points to findings by regulators that its vehicles

are involved in 40 percent fewer accidents when its autopilot software is installed.

The trickiest part of the transition to a self-driving future may be figuring out liability when accidents do happen. Instead of quarreling only about which driver was at fault, we will also be able to argue about whether the self-driving features in either car may have played a role. A preview of these complications was evident in the aftermath of the crash that killed Joshua Brown, the Ohio man whose autopiloted Tesla ran into a tractor-trailer. Federal investigators determined that the accident was not caused by a defect in the autopilot software, and Tesla has said repeatedly that drivers should always have their hands on the wheel even when they are using the technology. But officials noted that Tesla's technology was unable

to detect cross-traffic like that presented by the tractor-trailer. Tesla subsequently updated its software to make similar accidents less likely in the future.

So who was responsible for covering the damages? The insurance policy that covered Brown, who may not have fully understood the capabilities of his car, or Tesla? Neither Tesla nor Brown's family has commented on who paid. And both car insurers and insurance regulators have been relatively slow to contend with the difficulty in assigning liability when a person is driving a car only part of the time. "Insurance policies have not necessarily caught up with the global advancement of A.I. technology in cars," Brown's lawyer told me.

Not surprisingly, Silicon Valley, which is racing to raise the curtain on the era of autonomous vehicles, is also thinking about insurance. A start-up called Driav intends to bring down insurance rates by monitoring the reams of data coming out of self-driving cars in order to figure out, on a second-to-second basis, who or what caused the errors that led to a crash. "It's silly that claims are a 'he said, she said' argument," Dan Peate, Driav's chief executive, told me. "The data can just tell us what happened." The company hopes to begin offering insurance policies next year, with the expectation that they will be cheaper in part because the cars will be in fewer accidents and in part because it plans to be able to shift some liability onto the carmakers.

In the long run, when all vehicles are driving themselves, the manufacturers themselves are very likely to assume all of the blame for accidents. Most such companies have said that they plan to pay for anything that happens while their cars and software are in charge. When that's the case, insurance begins to look a lot more like a product warranty, covered by the carmaker, than a stand-alone product that a customer has to worry about. But in the transition years until then, there are likely to be a lot more messy arguments.

Nathaniel Popper is a technology reporter for The Times.

D.O.A.s

BY MARK O'CONNELL



When I think about the future these days, I inevitably return to a tweet from the writer Elizabeth Hamilton-Argyropoulos (a.k.a. @bourgeoisalien): "The saddest part about self-driving cars will be all the times people die mid-trip and then ur dinner guests or pizza guy will arrive dead." To read this joke is to become immediately certain that this will absolutely happen — of course it will! — and that it will furthermore become as much a part of the texture of everyday future life as, say, traffic delays caused by collisions are now. Admittedly, the dead-pizza-guy notion doesn't seem very likely: A large part of the impetus behind the development of self-driving technology in the first place is the desire to do away with the need for flesh-and-blood people who demand wages for their work. But the image feels symbolically resonant precisely because of the ghostly future of all those moribund jobs. Self-driving cars bearing the earthly remains of the recently deceased — automated Ubers, say, with heart-attack victims sprawled incredulously across the rear seat — are, in this sense, an extreme metaphor for the near future of capitalism. The technology will be miraculous, yes; but if it functions as intended, it will serve as an uncanny vector of human obsolescence.

Mark O'Connell is a writer based in Dublin.

From now on, security is designed around you.



Mobile alerts, remote control, and video streaming and recording require working internet and Wi-Fi. For Nest Secure alerts and remote control when Wi-Fi is down, get cellular backup, sold separately. Familiar face alerts require a Nest Aware subscription, sold separately, and are not available on cameras in Illinois.



Nest Cam IQ indoor



Nest Cam IQ outdoor

Wherever you go, you can see what's happening at home – inside and out. Nest Cam IQ security cameras can spot a familiar face or a stranger. And they're smart enough to know the difference.



From now on, this is security.



AWAKEN TO THE AWE OF THE EVERYDAY.

A waterfront oasis overlooking it all.

Luxury condominiums from the \$600 thousands to the \$6 millions
Over 31,655 SF of indoor and outdoor amenity space

SALES GALLERY NOW OPEN

*20-Year Tax Abatement Program
1.1% For The First 10 Years**

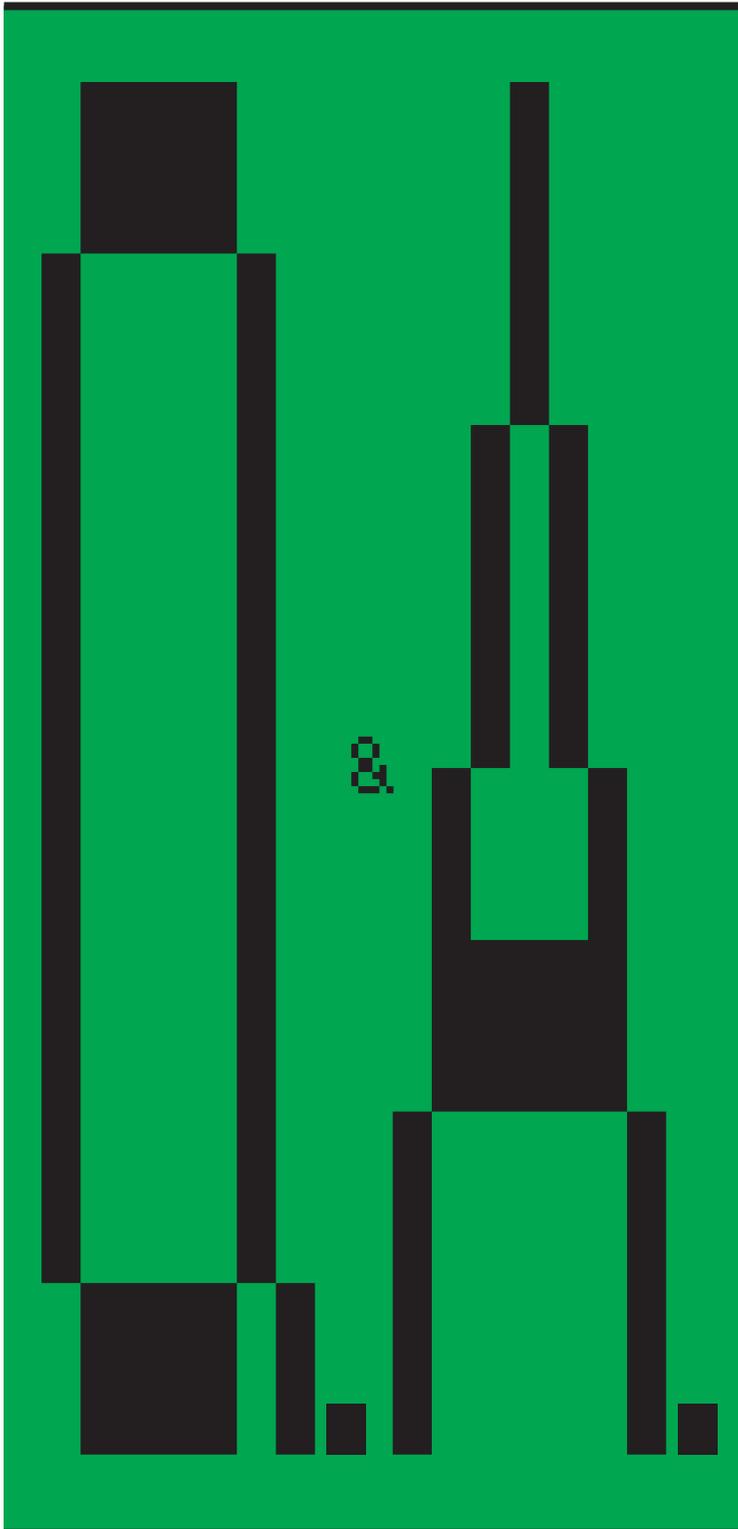
NINE

ON THE HUDSON

KHovnanian
AT PORT IMPERIAL
URBAN RENEWAL VI, LLC

khov.com/nine | 844.230.7459
9 Avenue at Port Imperial, West New York, NJ 07093

We are pledged to the letter and spirit of U.S. policy for the achievement of equal housing opportunity throughout the Nation. We encourage and support an affirmative advertising and marketing program in which there are no barriers to obtaining housing because of race, color, religion, sex, handicap, familial status, or national origin. All prices are base prices, subject to change and subject to availability. See Sales Consultant for full details. ©2017 K. Hovnanian at Port Imperial Urban Renewal VI, LLC. 110 Fieldcrest Avenue, 5th Floor, Edison, NJ 08837-3634. * Visit khov.com/nine for full details



A Whole New Lyft:

John Zimmer

INTERVIEW BY KEVIN ROOSE

Unless you're a millionaire or a truck driver, your first encounter with a self-driving vehicle will probably be a car you ordered through a ride-hailing app like Lyft or Uber. These companies, which spent the first stage of their lives trying to get drivers into their cars, are spending the next one trying to get them out. There will be some initial awkwardness around self-driving vehicles, just as there was around ride-hailing in the first place. (Remember when it was weird to get into a stranger's unmarked car?)

But Lyft, for one, is betting that it can put a trustable face on the tech. In July, it announced Level 5, a lab where it will work on its own driverless software, in addition to developing an open self-driving network that companies like Ford and Jaguar Land Rover will be able to plug their vehicles into. The idea of the network is to combine multiple kinds of autonomous vehicles under one routing-and-request system, so that when you order a Lyft, the app will assess your route, check the weather and other factors and send you the best ride, whether that's an autonomous Waymo or a human-driven S.U.V. John Zimmer, Lyft's co-founder and president, explained its thinking.

Uber built its own self-driving technology. Why did you decide to do it the way that you did? We weren't in a position to start this effort two or three years ago. But by being later to launch, we're able to take a different approach. Many platforms and technology have changed a lot in the last couple years. There are things that we can skip over.

Lyft made people comfortable with riding in strangers' vehicles by having pink mustaches on the front of the cars and friendly drivers. How do you plan to make people comfortable with a car that has no driver? I think that the first wave of autonomous vehicles will look very similar to the ones currently on the road, but as we move to the second wave, they'll be more like a room on wheels. In a situation where you have 10 or 12 people in a car, we will have more of a shared-vehicle experience. In those cases, having a driver-host will make a ton of sense. Having hospitality delivered

by other people is another way to make users comfortable — that's why we don't think there will ever be a moment where there would be fewer drivers or fewer job opportunities.

You don't think that there might be fewer Lyft drivers even 20 years from now? I think you'll have way more. The cost of owning a car is \$9,000 a year. Let's say we offer a \$500 monthly plan in which you can tap a button and get access to transportation whenever you want it, and you get to choose your room-on-wheels experience. Maybe you want a cup of coffee on your way to work, or you want to watch the Warriors game later, so you're in what's basically a sports bar, with a bartender. If 0.5 percent of all miles driven are done on a ride-sharing app, and then if that number increases to, say, 80 percent, it'll be such a huge industry shift that even if only 2 percent of that 80 percent is done by human drivers, it still represents a drastic increase in the number of human ride-sharing drivers.

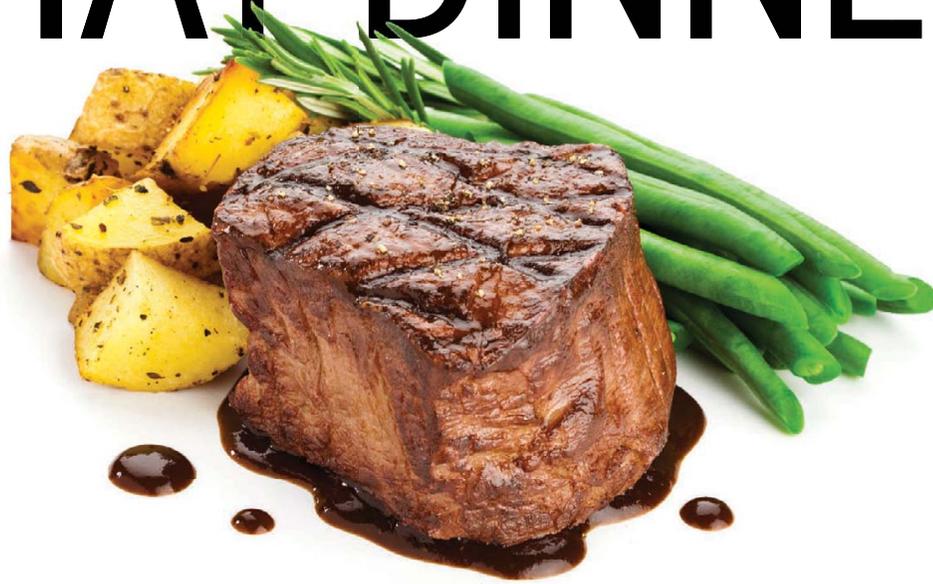
Will there be a price difference between human-driven cars and autonomous cars? Maybe in the early days, people will pay more for the service, and again in the long term, when it's a full-on experience. There are a lot of variables.

When cars first replaced the horse and buggy, there was a backlash from people who thought they would take over. Do you think something similar will happen in the next few years as people start to see autonomous cars on the road? If companies don't do a good job of explaining what's happening and how it will impact society, that's possible. I'm confident in how Lyft is going to behave.

Right now, you guys want to be everyone's friends in this industry. Will there be a time when the business becomes more mercenary? We'll see. We've never seen a shift like this in our lifetime. To think that only one or two companies will handle the transition is incorrect.

Kevin Roose is a business columnist for The Times and a writer at large for the magazine.

THAT DINNER



WON'T PAY FOR ITSELF.

Switch to GEICO and save money for the things you love.

Maybe it's that high-end client dinner. Or the last-minute flight overseas. Doing business is what you love – and it doesn't come cheap. So switch to GEICO, because you could save 15% or more on car insurance. And that would help make the things you love that much easier to get.

GEICO[®]
Auto • Home • Rent • Cycle • Boat

geico.com | 1-800-947-AUTO (2886) | local office

Some discounts, coverages, payment plans and features are not available in all states or all GEICO companies. Homeowners and renters coverages are written through non-affiliated insurance companies and are secured through the GEICO Insurance Agency, Inc. Boat and PWC coverages are underwritten by GEICO Marine Insurance Company. Motorcycle and ATV coverages are underwritten by GEICO Indemnity Company. GEICO is a registered service mark of Government Employees Insurance Company, Washington, D.C. 20076; a Berkshire Hathaway Inc. subsidiary. © 2017 GEICO



The Future of Sex in Cars

BY MOLLY YOUNG

For reasons that have gone unstudied, humans become horny in transit. With the proliferation of subway systems came the proliferation of subway gropers. With commercial air travel came the “Mile High Club.” Pamela Anderson and Tommy Lee filmed their famous sex tape on a boat (I’m told). There’s something about transportation that gets people in the mood. What is it?

My theory is simple. In our capacity as humans, we have three speeds at which we operate: crawl, walk

and run. In other words: extremely slow, slow and slightly less slow. When we engage with equipment that increases our velocity, we become excited. This excitement applies in all cases, whether we’re talking about an escalator, a moving walkway, a bicycle, a roller coaster, a golf cart or a Chrysler LeBaron. It is fundamentally thrilling to travel at an unexpected speed. When the enabling mode of transportation is one that permits our excitement to be processed as erotic energy — even if that processing is specifically legislated against — some of us will do that. The distance between “excited” and “stimulated” is, after all, incredibly short. If there were a way to have sex on a bicycle, people would be bike-sexing all the time. It would have its own verb.

Having sex in a car is not currently impossible, but it is difficult. Hand-eye coordination, a mechanism critical for sex-having, is compromised for the driver, whose hands must remain on the wheel and eyes on the road. In road couplings, the driver is not an equal contributor. Unless, of course, the driver doesn’t

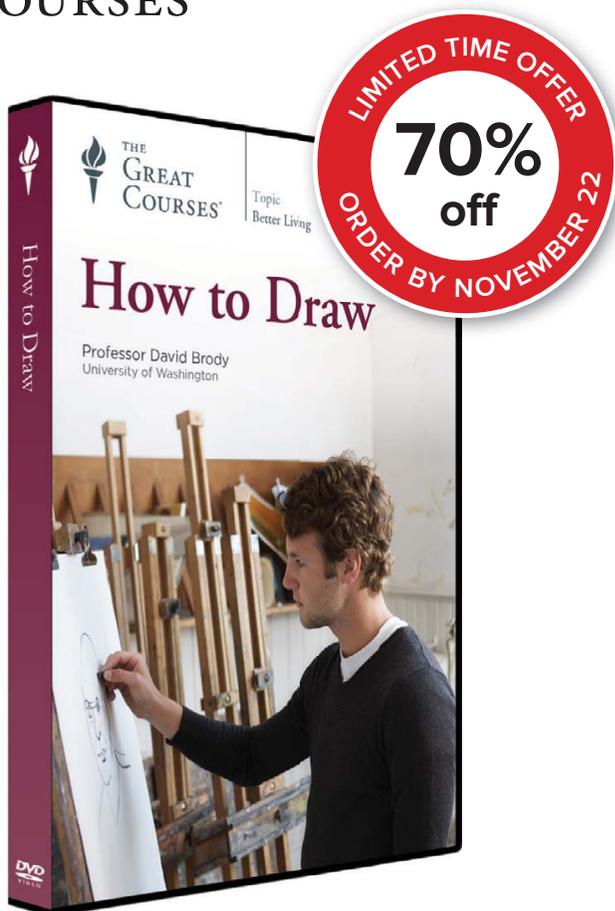
need to drive at all. Which brings us to the self-driving car: basically a motel room on wheels. The one hindrance to this development is existing public-lewdness laws, which are fairly expansive. You can’t intentionally get naked and perform a “lewd act” in a public place without risk of penalty. Obviously. But you also run a risk if you perform your lewd act in a private place with the intention of being watched — say, in a self-driven automobile slowly cruising past a school bus where my future grandchildren are watching in horror as a frenzied orgy unfolds within smelling distance. I am confident, however, that the law will be updated to distinguish between acceptable and unacceptable car-based encounters.

And if not, industrial designers can come up with clever “solves,” the word that start-ups use for some reason instead of “solutions.” If car windows no longer need to function as navigating aids, why not tint them to inky obscurity? Or replace them with mirrors facing outward? Or mirrors facing *inward*? Or remove them entirely? Future riders may not even need a human partner in

order to have an intimate appointment. Nissan is working with Microsoft to develop an “in-vehicle virtual personal assistant” which, if deviously hacked, could provide the 21st-century equivalent of phone sex.

More interesting than the aesthetics of car sex will be the cultural consequences. New slang terms will arise. New positions. New trophies. (How many times can you have sex in the time it takes to drive from Las Vegas to Los Angeles?) Virginites will be lost, children conceived, marriage vows consummated and violated. Car-based kinks will be minted and postcoital rituals established. New professional opportunities will emerge: interior decorators who specialize in “self-driving bedrooms”; entrepreneurs who launch apps to enable no-strings-attached in-car assignments. Preferences will be identified and explored. The world will expand in narrow but pulse-quickening ways — not a sexual revolution, but a plot twist. ♦

Molly Young is a contributing writer for the magazine.



Uncover Your Hidden Talent for Drawing

Like reading and writing, drawing is a fundamental life skill. Once an integral part of a traditional education, knowledge of drawing deepens your understanding of the visual world that surrounds you. Contrary to what many people think, the ability to draw does not depend on innate talent or a unique gift. In fact, you may be amazed at how well you can learn to draw, especially with the right instructor.

The 36 video lessons of **How to Draw** offer you dynamic and comprehensive training in the art of drawing. Your teacher, David Brody, brings more than forty years of study, studio work, and dedicated teaching to this course, demonstrating an inspiring teaching style and limitless insight into the learning process. This brilliantly designed course takes you step by step through all of the key elements that together build the integrated skill of drawing. This is your opportunity to master the primary skill of visual art, an ability with rewards you will treasure for a lifetime.

Offer expires 11/22/17

THEGREATCOURSES.COM/8NYM
1-800-832-2412

How to Draw

Taught by Professor David Brody
UNIVERSITY OF WASHINGTON

LECTURE TITLES

1. An Introduction to Drawing
2. Drawing Materials for Line
3. Drawing Fundamentals and First Exercises
4. Line and Shape: Line and Aggregate Shape
5. Line and Shape: Volume and Figure-Ground
6. Line and Shape: Positive and Negative Shape
7. Composition: The Format and Its Armature
8. Composition: How Artists Compose
9. Line and Shape: Line Attributes and Gesture
10. Composition: Shape and Advanced Strategies
11. Proportion: Alberti's *Ve/o*
12. Proportion: Accurate Proportion and Measure
13. Creating Volume and Illusionistic Space
14. Six Complex Drawing Projects
15. Linear Perspective: Introduction
16. Linear Perspective: The Quad
17. Linear Perspective: The Gridded Room
18. Linear Perspective: Ellipses and Pattern
19. Linear Perspective: Advanced Topics
20. Value: How Artists Use Value
21. Value: Drawing Materials for Value
22. Value: Black and White and a Value Scale
23. Value: Eight Complex Drawing Projects
24. Value: Side Light and Cast Shadow
25. Value: Oblique Light and Cast Shadow
26. Texture: Mark Making and Optical Value
27. Texture: How Artists Use Texture
28. Color: Color Theory and Color and Light
29. Color: How Artists Use Color
30. Color: Color Drawing Projects
31. The Figure: A Canon of Proportions
32. The Figure: The Head, Hands, and Feet
33. The Figure: Artistic Anatomy
34. The Figure: Drawing Projects
35. Advanced Concepts: Pictorial Space
36. Advanced Drawing Projects

How to Draw

Course no. 7770 | 36 lectures (30 minutes/lecture)

SAVE UP TO \$270

DVD ~~\$384.95~~ **NOW \$114.95**
Video Download ~~\$334.95~~ **NOW \$84.95**

+\$15 Shipping & Processing (DVD only)
and Lifetime Satisfaction Guarantee

Priority Code: 152255

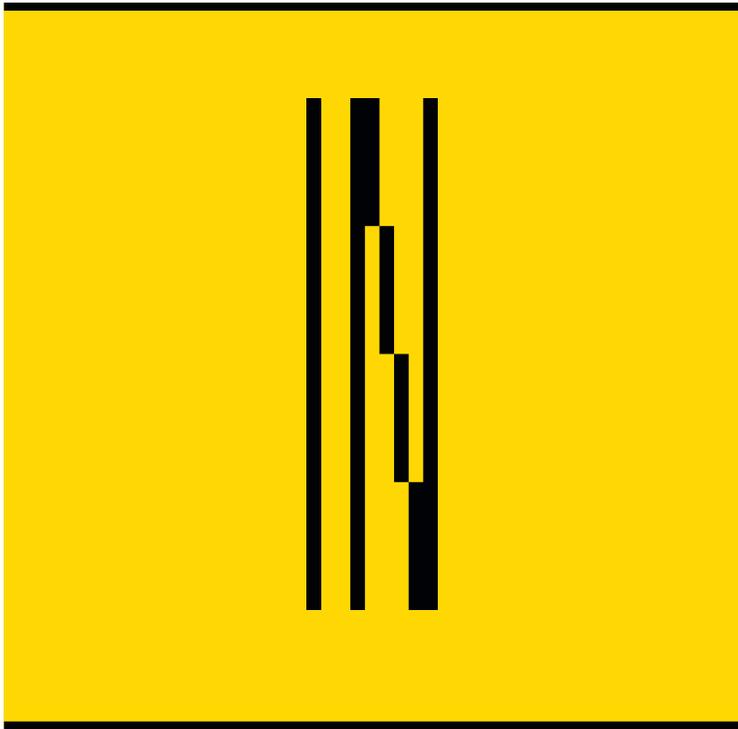
For over 25 years, The Great Courses has brought the world's foremost educators to millions who want to go deeper into the subjects that matter most. No exams. No homework. Just a world of knowledge available anytime, anywhere. Download or stream to your laptop or PC, or use our free apps for iPad, iPhone, Android, Kindle Fire, or Roku. Over 600 courses available at www.TheGreatCourses.com.



While companies race to make cars autonomous, a less-heralded group of researchers is plotting something even more profound: making them cooperate.

BY KIM TINGLEY ILLUSTRATION BY SIGGI EGGERTSSON





his 31-year career delivering frozen patties, ketchup packets, ice cream and such to McDonald's, Baskin-Robbins and other restaurants across the country, Dave Mercer logged more than three million miles, many of them in rigs he termed "bad news": boxy, twin-stick-shift trucks that belched smoke and had no heating, air conditioning or radio. But they were sleek compared with the 18-wheelers his father drove before he was born. His father used to say that going uphill he could walk faster than his load; sometimes he would stand out on the running board to cool off and steer one-handed through his open door. "You're not going to stop technology," Mercer told me, when I asked him why he had decided to finish his professional life by test-driving trucks full time for a four-year-old Silicon Valley start-up. We were standing on the side of I-280 in Mountain View, Calif.; Mercer, wearing a Hawaiian shirt and dark glasses, had just finished demonstrating a system that a company called Peloton Technology plans to introduce in commercial fleets next year. "I wanted to come over and be a part of this before I retired," he said. "I can tell some of the younger drivers. . . ." In lieu of finishing his thought, he punched his co-pilot, a quiet computer engineer, in the shoulder. Hundreds of hours riding shotgun with Mercer — panoramic views of the horizon, cars flowing streamlike down below — had inspired him and several of the company's other engineers to get a commercial driver's license. "I want to be part of that, too," Mercer said.

Someday cars will drive themselves and coordinate with one another and smart cities and roadways to eliminate traffic jams and accidents — including the fatal one that happens in the United States every 15 minutes — while reducing fuel consumption and effectively giving back to Americans an annual per-capita average of 335 hours in which, for better or worse, they can use their hands and eyeballs in other ways. When and in what shape this utopian future will arrive, though, remains a persistent mystery. What is certain is that those who play the largest roles in solving it will be in a position to dictate — as those who control infrastructure always have been — which people and places they will empower and which they will upend.

An intelligent automated future, however, depends on the maturation of two entirely separate sets of technologies. The first — and the one that has drawn most of the investment and media attention in the last five years — will allow vehicles to drive themselves without any input from their surroundings. The other set of technologies will connect vehicles to their surroundings and to one another, in order to optimize the functioning of the vehicular ecosystem as a whole. Ultimately, these two types of systems

will have to complement each other, yet neither can be implemented all at once. In the meantime, the process of developing and deploying them often puts them at odds. Indeed, the two systems are, in a sense, philosophically opposed: libertarian self-reliance in a race with socialist collectivity to be the first to improve traffic flow.

In Silicon Valley and elsewhere, where numerous start-ups are competing with software giants like Google and Uber in the "self-driving" category, Peloton has left high-level automation out of its immediate business plan. Rather, it has staked its early success — and the money of investors like UPS, Volvo and Intel — on a cooperative technology known as "vehicle-to-vehicle communication," or V2V, which makes use of a shortwave portion of the radio spectrum that the Federal Communications Commission set aside in 1999 primarily for traffic-safety messaging. A signal can zip through this bandwidth thousands of times faster than the second or two it might typically take a driver to react. This valuable swath of ether (worth billions to the telecommunications industry, which is currently lobbying the F.C.C. to "share" it) facilitates unlimited potential applications, not just for sending data among vehicles but also for syncing them with traffic lights and other features of the environment. Currently, vehicles using it — the vast majority belonging to research pilot projects — broadcast encrypted information 10 times per second to any receivers within 1,000 feet that can decode it. This means that, unlike vehicles that are automated but not connected, they can "see" beyond their actual field of view: an accident just over the crest of a hill, an oncoming car around the corner. "It will save lives, and everybody knows that," says Harry Lightsey, the executive director for emerging-technologies policy at General Motors, maker of the 2017 Cadillac CTS, the first commercially available car in the United States to carry the technology. "A delay in rolling out V2V will cost lives, and that's a tragedy."

It has been nearly two decades since the F.C.C. allocated bandwidth to be used primarily by V2V. So why does talk about the future of transportation tend to be dominated by fully automated vehicles? One reason is that most people simply assume automation includes connectivity to others on the road. It is also hard to explain what V2V is: Like the internet, it describes a medium with many possible uses, not a stand-alone product. Nor is there a single definition in play, really; though V2V typically refers to systems that operate in the F.C.C.-dedicated bandwidth, it can technically mean any type of connection among vehicles, or between vehicles and infrastructure (V2I) or "everything" (V2X). Like the telephone's, too, its value is contingent upon its dissemination — early customers, with no one to "call," must buy into an abstraction.

Peloton believes that trucking companies are the natural place to start: They can outfit entire fleets at once and reap significant benefits from small improvements. Moreover, most of the 279 billion annual miles trucks travel are on highways, which are far more predictable than city streets and therefore an easier environment in which to usher in new driving features. Thus, the trucking industry is poised to be among the first to adopt both V2V and automated technologies on a grand scale, possibly becoming the arena in which they will compete with each other most ferociously for initial relevance and public acceptance.

On the day I met Mercer, he and Jake Gregory, a veteran F.B.I. agent who drove trucks in college and directed safety operations for a small fleet after leaving the bureau, were demonstrating Peloton's first V2V application, called "platooning," in a pair of 18-wheelers. ("Peloton," the French word for "platoon," also designates the main pack of cyclists in a road race.) They eased out onto I-280 with Mercer in the lead. I rode with Gregory, whose cab had been retrofitted with theater-style seats where a bunk bed used to be. These were occupied by Steve Boyd, a Peloton founder, who oversees external affairs; Oliver Bayley, the head of user experience design; and Rod McLane, the company's marketing manager.

The specialties of these — user experience and public relations — were reminders of the "social problem" (as Bayley put it) that nags at Peloton.

Their product is ready, and they expect to outfit hundreds of commercial trucks with it in 2018. But legislators, the general public and, crucially, truck drivers still fear it, often confusing it with automation, which many see as a threat to drivers' jobs. (Even companies about to put it in their fleets decline to be named.) This unease is reflected in the rejection of the terms "self-driving" and "autonomous" in recent recommendations from SAE International, which publishes industry standards. Boyd, a former assistant press secretary for the White House, explained: "'Autonomous' is: You get into the truck and say, 'I want to go to the office,' and the truck says, 'I want to go to the beach.'"

Gregory flipped a switch on the dash, and a screen — mounted where a car's rearview mirror usually is — blinked on. "Platooning not authorized in this area," it said. The system, Gregory said, was calculating the weight of Mercer's truck ahead: "It takes a few minutes for it to establish mass." The software also used a cellular signal to check with a cloud-based server run by Peloton engineers to see if Gregory was in an appropriate location: a divided highway accessible by only on-off ramps, more easily negotiated than crossings.

The system chimed, and the message changed: "Ready to platoon." Gregory pressed a button that allowed Mercer's truck to take control of his throttle and braking systems over the V2V bandwidth. It began to reel Gregory's truck in until they were exactly 66 feet apart. By maintaining that gap, it created a slipstream that reduced carbon emissions and saved fuel by an average of 7 percent: 10 percent for the follower and 5 percent for the leader. (A team led by researchers at Purdue University, with a grant from the United States Department of Energy, believes it can help Peloton increase the average to 20 percent, which the team estimates would be worth up to \$20 billion a year to the trucking industry.)

While continuing to steer, Gregory removed both feet from the pedals and planted them on the floorboard. Mercer slowed at an exit ramp, and Gregory's truck automatically did, too, beeping at him to resume control. When I first heard about platooning, I imagined it would feel more death-defying, but though the size of the gap had initially unsettled Mercer and Gregory, it attracted little notice on the highway; oblivious passenger-car drivers frequently cut in, dissolving the platoon. In practice, the exercise felt more like an elaborate cruise-control upgrade than the opening bell in a transportation revolution. Bayley agreed: "It's disappointing!"

Critics of V2V, especially those who are solely invested in full automation, dismiss platooning as mere high-speed tailgating. The major added safety benefits, they point out, come from the fact that, in order to platoon, trucks must be equipped with advanced safety features. Peloton readily agrees that its application, whose requirements include air disc brakes and state-of-the-art collision-avoidance, is an incentive for fleets to upgrade. V2V proponents, on the other hand, hope to leverage renewed federal interest in their systems to expand projects that have been gestating for decades. The Department of Transportation, under the outgoing Obama administration, proposed requiring that all new passenger vehicles be equipped with V2V — at least symbolically moving toward the realization of those goals. Earlier this month, however, reports suggested that the Trump administration might be inclined to shelve the proposal. "It's important to get our government leaders to commit to this," says Larry Head, an engineering professor at the University of Arizona, who is collaborating on V2I applications with Peloton. "We can't wait five years. We're ready now."

To connect in any way is to cede control and reconfigure vulnerability. The history of civilization is one of trading pure independence — living alone in a cave, say — for comfort of one kind or another: companionship, enhanced productivity, protection. On balance, it is hard to argue that this exchange has not worked out in our favor. But the benefits of communing also exact steep prices — war, climate change, economic inequality — that are suffered individually. Since the completion of the first transcontinental railroad in 1869 transformed the American landscape and economy, public

transportation and infrastructure have given physical shape to moral questions that arise when we are forced to choose between self-interest and the greater good. In 1967, the British philosopher Philippa Foot posed a thought experiment that became known as the "trolley problem." A runaway trolley is headed for five people tied to its track. You are standing next to a lever that can divert the trolley to another track, where it will kill a single person. Is it more ethical to pull the lever or not?

As a society, we routinely make comparable decisions: when we let football players give one another brain damage in the interests of public entertainment; when a surgeon refrains from killing one terminal patient and transplanting his organs into five patients whom they might save. The trolley problem heightens individual culpability by bestowing absolute decision-making power on one person and demanding that she select not between actions but consequences, which in real life are rarely inevitable. Arguably, in doing so, the dilemma tends to reveal our natural inclination to accept fate over premeditation in situations with no happy outcomes, even if planning might partly mitigate an otherwise inevitable tragedy.

In recent years, the trolley problem has frequently been adapted to discussions about entirely automated cars, which respond to contingencies with binary logic. Suppose a distracted mother pushes a stroller with her baby in it out in front of such a vehicle — should the car be programmed to hit them or swerve into a tree? Azim Shariff, the director of the Culture and Morality Lab at the University of California, Irvine, was an author of a 2016 report in *Science* that described a series of surveys he and colleagues conducted in which participants overwhelmingly approved of autonomous vehicles, as the study terms them, that would "sacrifice their passengers for the greater good" and "would like others to buy them." Unsurprisingly, however, they expressed a preference to ride themselves in autonomous vehicles that protect their passengers "at all costs."

Engineers tend to scoff at the trolley exercise. ("I think the vehicle's going to stop," Larry Head told me.) But Shariff says this response takes the problem too literally. "That particular scenario may never come up, but the fundamental ethical trade-off that it's revealing, apportioning risks among people on the road, is going to happen all the time," he said. "It already does." Inching closer to a cyclist in the right lane to move farther from a semi on the left, for instance, prioritizes your safety over the cyclist's. Leaving that "decision" up to your subconscious becomes its own ethical choice, he added, once "the luxury of deliberation" embodied by the preprogrammed car exists. Human error contributes to an estimated 95 percent of crashes; in theory, automated and connected cars can eliminate our mistakes. "If you recognize that one option is safer," Shariff says, "and you choose the other option, that's a moral decision."

At the moment, V2V merely transfers information without dictating how it is used. But as its reach expands, potentially linking drivers, carmakers and telecommunications companies with state, city and local governments and other private and public interests in a vast network orchestrating the use of what are essentially lethal weapons, questions of responsibility become more complicated. V2V-enabled vehicles would broadcast their size, speed, acceleration and braking activity and location (down to the lane), according to the latest standards. Who will be allowed to access that data? Will it remain anonymous, as automakers currently intend? Who will defend the network against hackers and keep up-to-date the critical software that collects, analyzes and translates that data into best practices for each of its users? Do drivers have the ultimate right to control their cars — even if they want to speed, say — or should the network be programmed to prevent them from doing so? Should it matter whether they're flooring it because they're drunk or delivering a pregnant woman in labor to the hospital?

Of course, governments and standards organizations already confront similar utilitarian questions. Early airbags were designed to protect men of average height and weight at the expense of those outside the bell curve; when ambulances run red lights to save a dying patient, they increase the risk of death for everyone around them; a turn-only lane might be safer for bicyclists but worsen vehicle congestion (Continued on Page 79)



If 100% of cars ever drive
themselves, our familiar
car culture would die — and
a new one would arise.

So, wow, imagine we get there: total autonomy. Manual driving is outlawed. Our cars are better drivers than we ever were. And not only that, they coordinate with one another in an elegant choreography, threading through traffic with inches to spare. Parking becomes parkland, because no cars ever stay still for long; they stop only to recharge themselves as needed. If you choose, you can just hang out at home and let the robocars bring you everything you need. But even if that future does arrive, it would come with a trunkful of nagging questions. What does it *feel* like to live in that world? And how does 21st-century society — which has been built, in ways large and small, around human drivers — change and reconfigure when they all become mere riders? In the pages that follow, we begin to wonder at some answers.



Post-Sign Life

BY CLIVE THOMPSON

Street signage is the iconography of the automobile age. It's like highly functional pop art: silhouettes of schoolchildren, white arrows, rectangular cries of WRONG WAY and, most central of all, the ubiquitous stoplight. The traffic light might be the first part

of that iconographic world to be transformed, or vanish altogether, once we are fully in the age of autonomous cars. Robots, after all, won't need signs to optimize the way they move through urban landscapes.

Urban-transportation experts have been busily creating computer simulations to show how this might work. In one model, each crossroads would have an "intersection manager," a computer that senses the approaching traffic and uses wireless communication to talk to the oncoming cars. When each self-driving car is perhaps 300 yards away, it sends a request to the intersection manager — to turn right, say, or to move on through. The intersection manager then does an on-the-fly calculation to route that vehicle most efficiently, like an omnipotent and tireless traffic cop.

The result? A ballet of cars whizzing and weaving past one another in the intersection. Some slow down as they approach; others pass straight through. But crucially, compared with today's intersections, many fewer cars come to a complete halt.

This could significantly speed up traffic throughout an entire city. Peter Stone, a computer scientist at the University of Texas at Austin who works with one model, has found that the "delay" time at intersections shrinks remarkably. "Right now, it takes me an average of 20 minutes to get to work, but with autonomous-car intersections, it might be half that time," he says. Safety would be enhanced, too: Forty-three percent of car crashes in the United States occur at intersections, and Stone predicts that robot vehicles would crash only if there was a mechanical error. Better yet, autonomous intersections

could produce an estimated 20 to 50 percent less carbon dioxide, because there would be fewer idling cars and jack-rabbit starts. "That's the most expensive and most polluting part of driving," says Remi Tachet des Combes, a mathematician who created robot-intersection models while at the Massachusetts Institute of Technology.

For the human passenger, though, a robotized intersection could be mildly terrifying — like flying through a crowded asteroid belt, trusting the A.I. to find the right path. "At first I think it will be freaky," Stone admits. "Some people will need the window darkened so they don't freak out." But in the long run, we'll probably shrug, get used to it and barely look up from our games of Candy Crush as we zip through. And pedestrians? They would probably push a button at the intersection to request their turn — or even use a smartphone app.

More subtly unsettling, however, might be the spectacle of a city devoid of stoplights. Indeed, devoid of all major street signs: no huge billboards across highways naming the exits, no complex merge instructions. Those signs are expensive to build and maintain. They're designed for humans, and GPS-brained robots don't need them to know where they're going. Certainly, human pedestrians and cyclists will still need guideposts, but as Stone suspects, far fewer, and smaller, ones.

A world with almost no street signs would feel strange. It could make a city less cluttered and more attractive. But it might also leave us feeling unmoored. Social critics worry that GPS has already eroded our knowledge of the city; some studies have found that the more we rely on devices, the less we deeply intuit where we are and how to navigate on our own. "We become more helpless," as Greg Milner, the author of "Pinpoint," a history of GPS, told me. If robots rule the roads, we might get where we're going a lot more quickly — but end up not knowing precisely where we are.

Clive Thompson is the author of "Smarter Than You Think: How Technology Is Changing Our Minds for the Better."

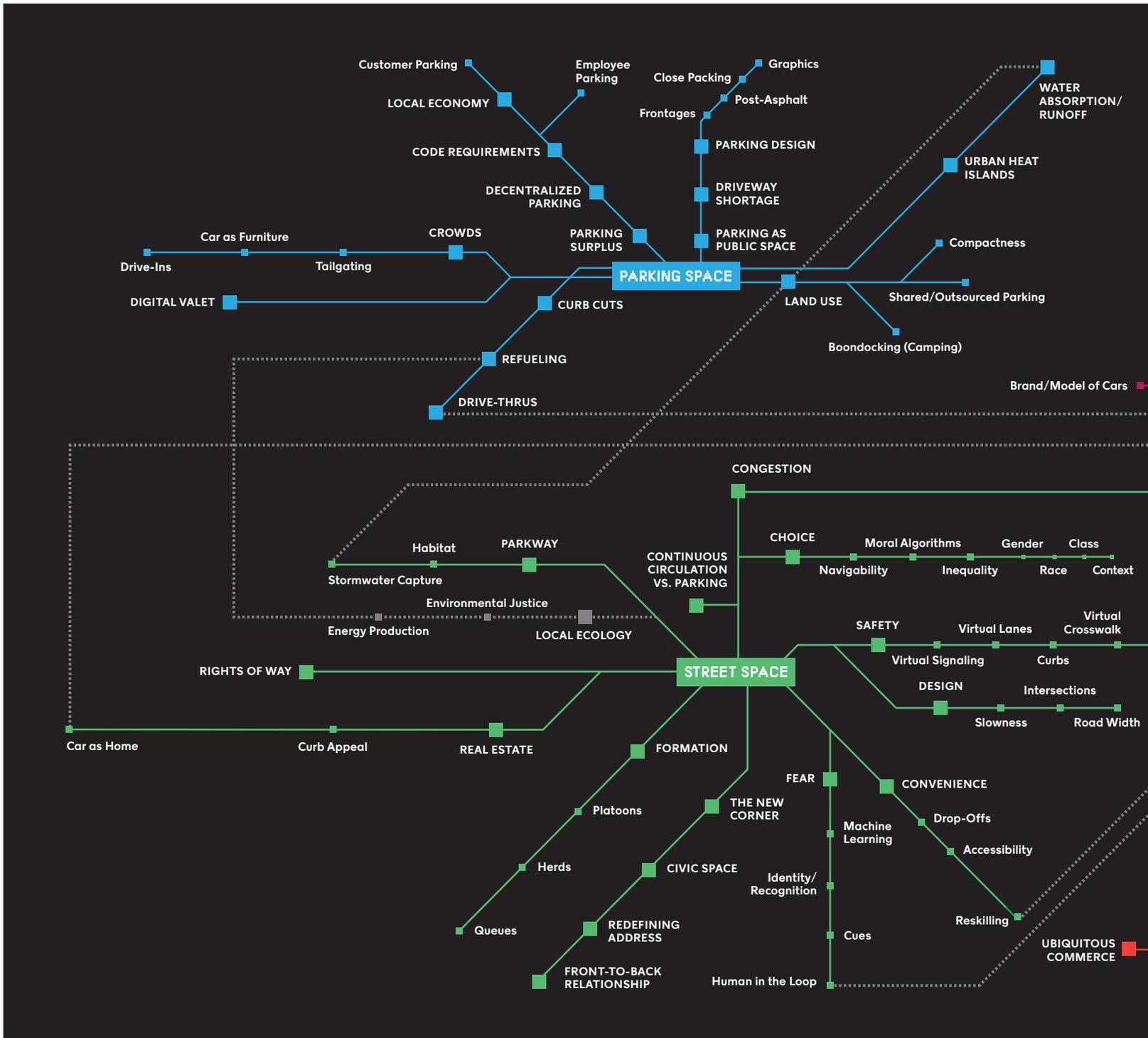
Picturing the Self-Driving City

BY ANNA WIENER

Marshall Brown, an associate professor of architecture at the Illinois Institute of Technology, recently traveled to Ann Arbor, Mich., to visit the Mcity Test Facility, the University of Michigan's 32-acre testing ground for automated vehicles. Mcity, which looks like a soundstage of a midcentury suburb, is a simulator: It has no actual residents. Still, Brown found it "bizarre and frankly frightening" that it looked as though the track had

been designed almost entirely by transportation experts, not urban planners or architects. He identified it as part of a larger problem: As technologists imagine the driverless world, they seem to be doing so with a distinct lack of imagination.

Brown is a creator of the Driverless City Project, an interdisciplinary research initiative at I.I.T. that takes a playful, rigorous approach to envisioning the fully autonomous future. The project helps



participants generate various situations for a city in order to determine how autonomous cars will fit into the picture. Central to the project is a “mind map” representing the group’s research, organized into four areas of impact: street space, parking space, commuter space and delivery space. The map, as well as other tools – including a set of large tokens for scenario building, like a tarot deck for urbanists – is meant to encourage others to be ambitious

and creative about the world in which they want to live. “We should write the future,” Brown says, “rather than trying to predict it.”

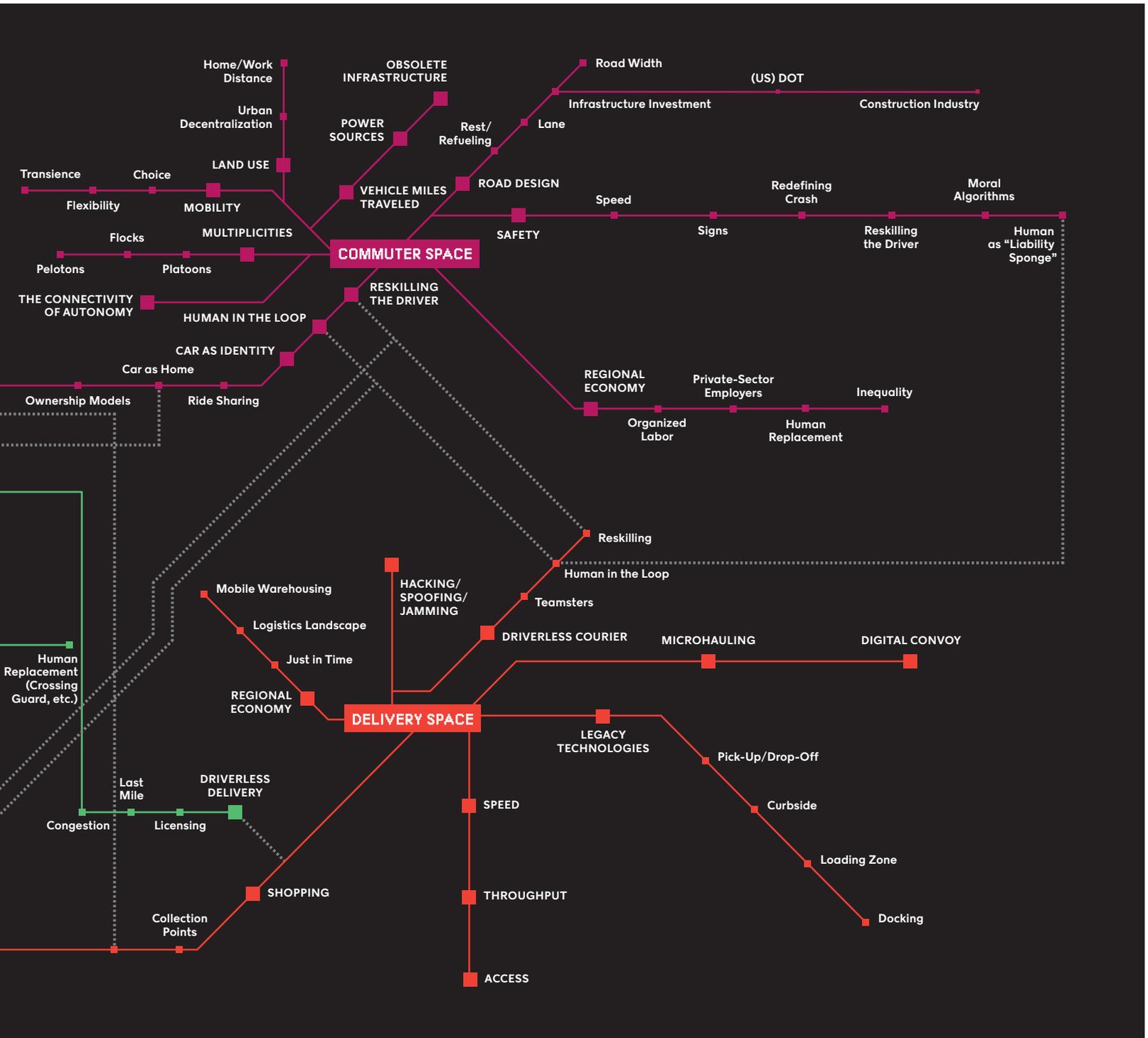
Brown has found two prevalent attitudes when it comes to self-driving vehicles: either an active but unimaginative approach, rushing to build robots to accommodate the world as it is now, or a totally passive approach, a sort of “wait and see.” The first, he says, is characteristic of the tech industry;

the second, of the public sector. “I hear too much surrendering in the question about our future right now,” he adds. “Just surrendering to Google or Amazon, or surrendering to your phone, or surrendering to a driverless car. We should not surrender.”

One way to stave off surrender, Brown believes, is to invite more

diverse thinkers, like architects and urban planners, into the process of imagining and designing the autonomous future. (He also listed sociologists, fiction writers, Buddhist monks, poets and rabbis as useful stakeholders.) The current discourse around the future of autonomous vehicles is centered on “technologically deterministic fantasies,” Brown says. He’s concerned that technological values – like logic, predictability and efficiency – will be erroneously

A rendering of the Driverless City Project’s “mind map.”



imposed upon the built environment, leading to urban spaces that fail to take into account delight, pleasure or human connection. “A society is cultural, and political, and aesthetic, and about desires — it’s not just how you solve problems,” he says. “They’re going to need more than just software engineers working on it.”

As an architect, Brown is especially attuned to the unlocked aesthetic potential of urban environments. Today’s visual clutter, necessary for keeping human-driven cars as nonlethal as possible, could be eradicated. It is critical, in his view, to consider the beauty and quality of the world that self-driving cars could bring.

It’s worth considering, then, where cars will go when people don’t need them. “What happens when a car can park itself anywhere?” Brown asks. He hypothesizes that parking, if performed robotically, could become “a negative externality, not unlike that of a trash dump,” should developers repurpose garages and parking lots

for more lucrative uses. (Why look for parking in Greenwich Village if the car can park itself on the edge of New Jersey?) In the Midwest, he speculates, deindustrialized cities with waning property values could even be bought wholesale and transformed into vast, flat parking lots — a future that he deemed plausible, if “too dystopian,” in no small part because of the likelihood that it would be pushed upon lower-income communities. On the other hand, those same communities could benefit from increased mobility and access to employment.

Brown is also considering the changes to storage: If robotic trucks constantly roam our landscape, will warehouses be abandoned? He’s focused on the changing needs and desires of a human driver. To accommodate an autonomous, cross-country route, truck cabs, he speculates, may need to expand according to a driver’s needs, perhaps going so far as to resemble a microapartment.

An emphasis (or lack thereof) on efficiency also addresses the temporal dimension of cities: It favors — or facilitates — a working lifestyle

in which there is never enough time. In a future of increased automation and accessibility, work culture may begin to shift; labor, and its attendant time constraints, may no longer be central to the urban experience. Brown envisions the possibility of a hands-free commute that opens up space for socializing — “an interior social world.” Riders could chat with people in adjacent cars or simply take the opportunity to watch the world go by. (A more cynical take on this, he says, is that the hands-free commute will simply increase the demands on workers, as the car becomes an extension of the home office — a WeWork on wheels.)

Second-order effects of autonomous vehicles tend to get lost in the techno-utopian chatter, but there seems to be an increasing awareness that self-driving cars won’t just arrive in cities; they’ll change them too. Some tech companies are beginning to get into data-driven city-building, a movement largely galvanized by the seeming inevitability of autonomous vehicles. Last year, Y Combinator announced a research initiative, New Cities, that aimed to study

how to build a metropolis entirely from scratch. In mid-October, Sidewalk Labs, an Alphabet subsidiary, announced that it will redevelop a 12-acre strip along Toronto’s waterfront, called Quayside, which will integrate technology across the human experience. The vehicles it is planning to accommodate will be shared, electric and self-driving.

Power and control over autonomous-vehicle technology is already concentrated in the hands of a small few: If a company like Uber or Alphabet controls the dominant transportation infrastructure, you need not live in an intentional community like Quayside to feel as though your city is becoming a company town. Brown is wary of the smart-cities initiative, and he resents the efforts of technology companies to fully saturate the human — and urban — experience. “A city is not a problem to be solved,” he says. “A city is a cultural construct, even though it involves the deployment of technologies. A city is not science alone.”

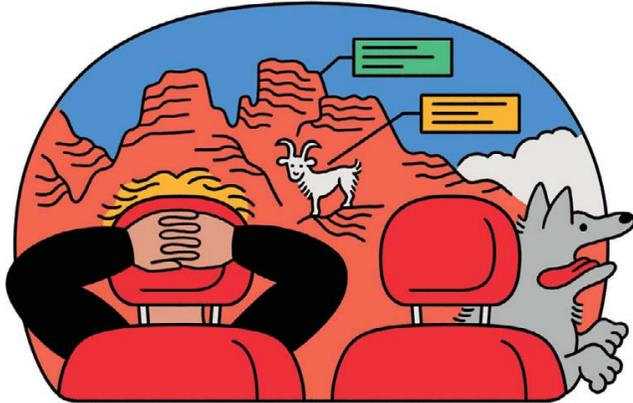
Driverless trucks could function as autonomous warehouses.

Anna Wiener is a writer based in San Francisco.



The Augmented-Reality Windshield

BY FERRIS JABR



For obvious reasons, our present-day cars are designed for keen observation of the outside world, offering a nearly panoramic view of the road and landscape through panels of glass. The parade of images flitting past a car's windows can be exhilarating or can induce a kind of pleasurable trance. By virtue of being transparent and inert, however, windows are inherently limited. Although we have begun to augment the car's field of vision with new layers of information — phones suction-cupped to the windshield, or GPS built into the dashboard — there is still so much useful knowledge just out of reach. Today's windows allow you to scope out a parking spot or search for that tiny cafe with the faded sign, but they can't help you find them. Nor can they show you exactly where that highway exit will lead or identify the odd building you just passed.

Tomorrow's could. Unlike Google Glass — which awkwardly placed screens where they didn't need to be — a car already requires a membrane between passengers and their environment. Why not turn that typically passive barrier into a dynamic canvas? Ordinary windows could be replaced with holographic glass or an advanced semitranslucent liquid-crystal display. They could anticipate our needs and instantaneously display weather forecasts, reviews of nearby restaurants and hotels, details about popular tourist attractions — and warnings about miserable tourist traps.

As the technology improves and people become more comfortable obscuring their surroundings, your windows could begin to overlay a vast digital diorama onto passing scenery. Passengers would no longer have to wonder about the

identity of a landmark and scramble to look it up on their phones. Instead, the car itself, wired with artificial intelligence, plugged into sophisticated mapping technology and equipped with magic eyes, would instantaneously recognize, annotate and augment its surroundings. A mountain, desert or coastline could become an interactive infographic, peeling away the physical surface of the earth to reveal hidden layers of geology. A self-directed double-decker bus ambling through London could rearrange the city like a Lego set, refashioning streets and buildings to illuminate the capital's rich history. Early television sets made the distant accessible; the self-driving car could reveal the invisible in the immediate.

As exciting as such possibilities are, recent history suggests plenty of reasons to temper our optimism. When windows double as screens, we will have the opportunity to gaze at the world anew through richly animated portals. Alternatively — and perhaps more realistically — we could end up staring into larger versions of our phones, distracting ourselves with email, mindless games and the infinite bazaar of the internet. The potential of the autonomous vehicle is to help us interact with our environment in ways never before possible. The temptation is to turn ever more inward, exchanging the physical world for yet another simulation.

Either way, self-driving cars with ubiquitous screens will inevitably bring all the familiar drawbacks of digital media onto the open road. Taxi TV in New York City is just a preview of the potential nightmare. What if the price for enchanted windows of the future is a nauseating kaleidoscope of advertisements, vapid movie reviews and contextless late-night jokes? Rather than learning about the hidden history of your surroundings, you may very well learn only about two-for-one cricket tacos in the food truck a lane over, homeowner's insurance for the Anthropocene or the sale on microdrones at a nearby mall. Don't want ads? No problem. You can upgrade to a premium account.

Ferris Jabr is a writer based in Portland, Ore.

Company Time

BY RAHAWA HAILE

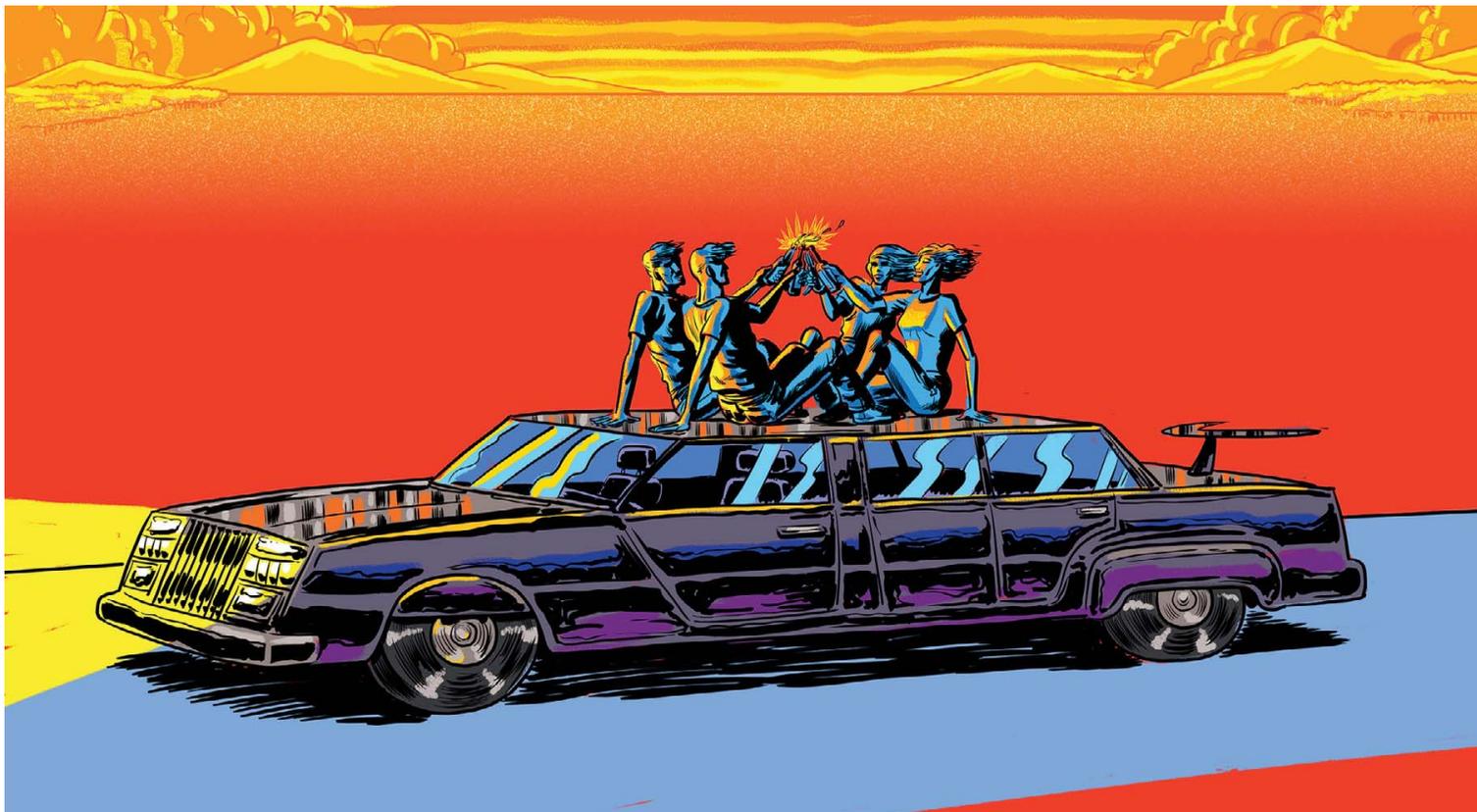


One big question about the driverless car will be who gets to own our new wealth of free time. Will it remain with commuters — or will corporations expect them to tap into the office as their vehicles ferry them there? While the potential for hours of unplugged leisure exists, the way we currently fill our downtime leads me to believe that some form of digital immersion will take precedence, as bosses expect employees to work on their way to and from work. It wouldn't be surprising to see the remaining minimum-wage positions in the rapidly automating food industry go to those who have access to driverless cars; use their cars for deliveries while they work, and you get two employees for the price of one.

It's tricky. On their surface, driverless cars will take some of the mess out of living, but they can also take the living where they don't want to go, both psychologically and physically. Some car interiors might more closely resemble cubicles. Or cells. Will private employers surveil workers in order to control off-duty behavior? It's also easy to conceive of a future where newly created infrastructure, explicitly dedicated to automated vehicles, will enable people with the means to own the cars to avoid the people without.

We should be wary of any technology that allows those with power to distance themselves even further from society.

Rahawa Haile is an Eritrean-American writer of short stories and essays.



Nonstop Teenage Party

BY GEOFF MANAUGH

In a short essay published in 1970, the British architect David Greene suggested that his colleagues pay more attention to cars. “A traffic jam is a collection of rooms,” he explained, and “so is a car park — they are really instantly formed and constantly changing communities.” It was a memorable observation that nonetheless would surprise few teenagers, who long ago embraced the transformative notion that cars are not just rooms, but rooms they can control.

Autonomous cars will once again transform teenage life. Anab Jain, a founder of the design studio

Superflux, says the ritual requirements of teenage socializing will inspire “a new range of acts and services that help you obfuscate your car’s identity or your own data.” Instead of trying to roll back the odometer on the family car à la Ferris Bueller, teenagers hoping to roam the city, free from parental view, might trick it into recording destinations they didn’t really visit. “The whole notion of freedom will change,” Jain says, even as some of the destinations remain familiar. Dark streets or quiet state parks where GPS doesn’t reach would be the coolest sites of all.

The question of when, exactly, the party has started will also become an intriguing one: After all, each car is a room unto itself. The Situationist International, a loose group of artists, political agitators and heavy drinkers who roamed the streets of Paris and other cities in the 1960s, treating them as arenas for detours and debauchery, offers some clues about how such rooms could be transformed. “I only ever hear self-driving cars talked about as a functional solution to the problem of getting from A to B,” says McKenzie Wark, the author of a history of the Situationists called

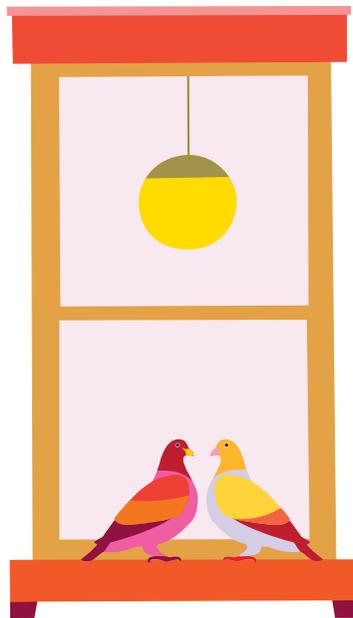
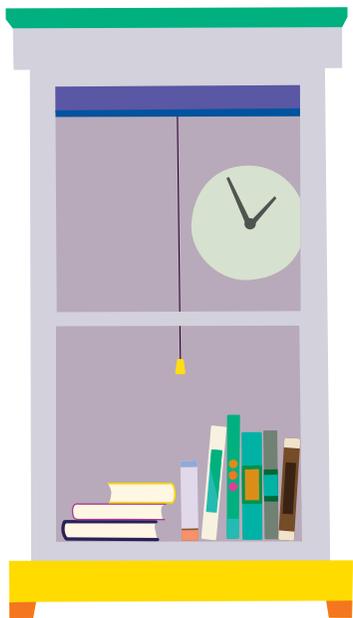
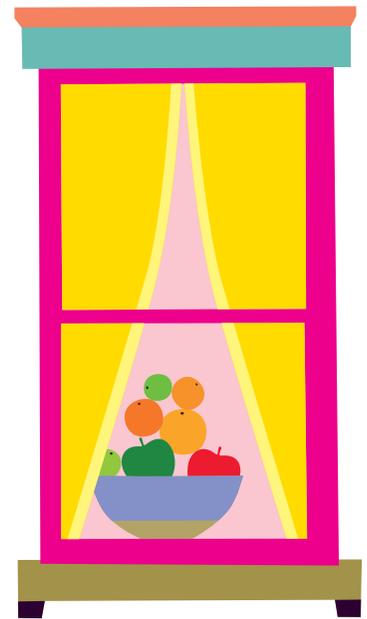
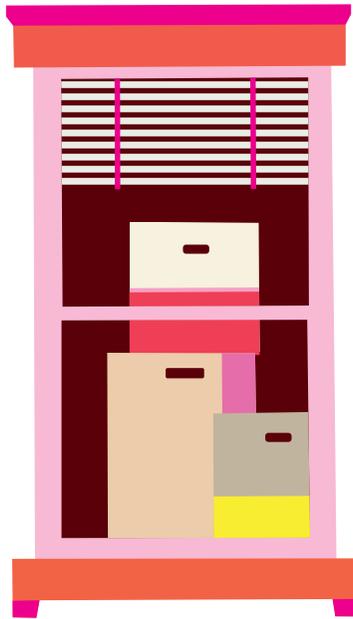
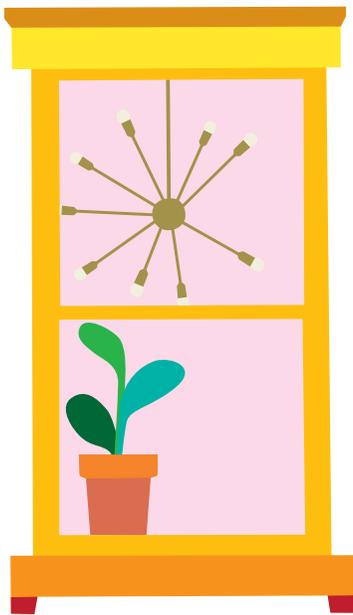
“The Beach Beneath the Street.” (The title is a reference to the sand that was revealed when protesters picked up cobblestones from the Paris streets to throw at the police.) Wark imagines these machines rolling out of the factory with more radical settings hard-wired into their operating systems. “A hybrid of the self-driving car and, say, Grindr could bring a whole new meaning to the concept of cruising,” Wark suggests. “There should be a ‘scenic route’ setting, a ‘random’ setting, a ‘surprise me’ setting. Or maybe ‘mystery destination,’ which whisks you — and algorithmically chosen others — to an undisclosed location. Algorithmic chicken for teenage drivers, where you drive head-on toward another car — then magically swerve off at the last minute.”

Unlike today’s cars, autonomous cars can also be made to swarm together, creating somewhat of a paradox: a moving traffic jam. Once the swarm is formed, proximity algorithms could mine social-media profiles to arrange like-minded clusters, while enabling “shuffle mode” might one day be the equivalent of texting a friend to rescue you

from the boring guy in the corner. Aspiring D.J.s will rely on software to assemble self-driving cars into the ideal configuration for louder bass. Couples armed with GPS jammers — the future’s perfect Valentine’s Day gift — will quietly steer strangers away, creating a halo of romantic privacy around their makeout sessions. If all else fails, hit “skip” to be transported to an entirely new party.

Hidden beneath the hormone haze of future block parties, new opportunities for cultural pranks and political protest will emerge. Rather than throw cobblestones, protesters could quickly jam the streets to show political solidarity or organize a strike. With the right programming skills, they might be able to shut down a whole city just by blocking a few crucial nodes. They could even open the streets back up to foot traffic, remaking them as a space for celebration. Then, of course, when it’s time to go home, all those dull factory presets, optimized for safety and efficiency, will finally come into their own — no designated driver necessary.

Geoff Manaugh is the author of “A Burglar’s Guide to the City.”



Helping you live better.
No matter where you live.

Real Estate

360 VIEW | CALCULATOR | VOYEUR | RENTERS | THE FIX

Visit nytimes.com/realestate

Your Autonomous Dealer

BY JAMIE LAUREN KEILES

Drug dealers tend to choose cars at the extremes — on the one hand a cocaine-white G-Wagen, on the other a '98 Toyota Tercel. Each suggests a kind of shady guarantee that the self-driving car isn't likely to sustain. Like most new stuff from Silicon Valley, the autonomous car is bound to be cute — a gumdrop whip fit for a Pixar protagonist.

Hardly what you dream of when you're trying to score. If drugs are still cool, they'll have stayed that way in part because of their illicitness and the mild supply-line chaos that brute fact engenders: the inconsistent product, unreliable hookups and hours spent waiting for the dealer to arrive. Self-driving cars will succeed only by reducing

and avoiding such chaos as much as possible. If these two industries are ever to play nice, then the success of one will come at the cost of the cool-guy reputation of the other.

In the self-driving future, a weed transaction will begin the same as always — by texting your dealer in search of “tree,” or by casually asking if he wants to “hang out.” En route to another customer's house, he will text back immediately, freed from the imposition of two hands on the wheel. Memories of waiting impatiently on a flaky dealer will recede as his car appears on your app, predicting arrival time down to the minute. Watch as his vehicle weaves around school zones, or is maybe flagged and pulled over by the police. The new possibilities for surveillance are endless.

In any case, if he makes it to your house, it is likely that he will

emerge from his self-driving pod in a sweatshirt for a company with a name like TökTaxi or Gangl.ly or Lyft'd. As weed begins to trend toward legality, we've already seen such standing-desk branding start to creep into the stoner vernacular. A scan down PC Magazine's “15 Blazing Hot Weed Tech Companies to Watch” reveals Tokken (a blockchain system for dealers), Mass-Roots (a stoner social network) and Eaze (the obligatory “Uber for weed”). In this new age of cannabis, the only thing that moves faster than the tech is the rate at which smoking itself becomes corny.

But cringe-worthy orthography is not the only thing that this self-driven industry will inherit from Silicon Valley. In the age of semi-autonomous cars, dealers will be forced to file 1099s, sharing their profits as lowly subcontractors. As in the time when dealers drove themselves, this fleet of buddies-for-hire will offer five to 10 minutes of humanity-affirming chitchat. Unlike preautonomous dealers, they will plead that you tweet their referral codes in order to receive a complimentary edible.

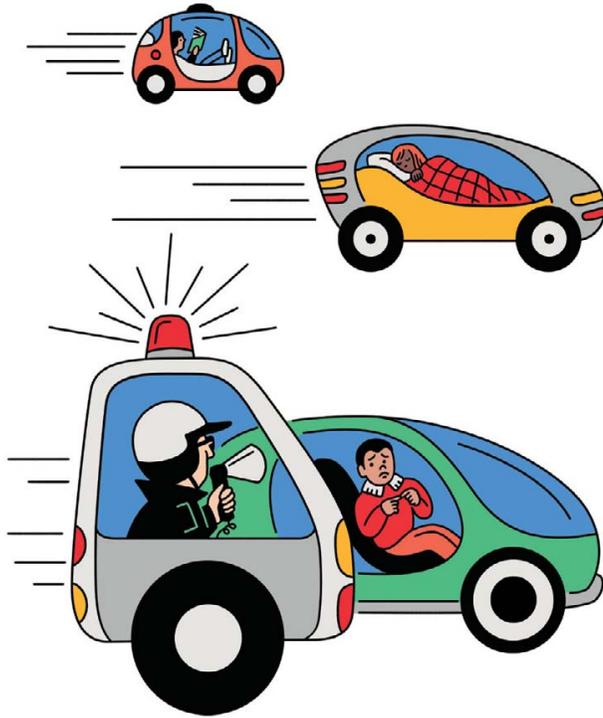
This, of course, is one good reason to strive for fully autonomous drugmobiles. The driverless vehicle eliminates small talk, supplying your fix directly from the glove box with a personalized passcode, à la Amazon Locker. With no human body attached to the cargo, suppliers will seek to move harder drugs, in bigger quantities, potentially unleashing a new set of problems. The narc, a liability throughout all of human history, isn't likely to go anywhere soon. Self-driving cars will scan for hazards in the street but will also pick up telltale signs of an informant: nervous twitches, too-enthusiastic slang. A customer might even be asked to answer a question like, “Are you a cop?” (Because, as all drug dealers know, a real cop has to say yes, even to an A.I.) It is likely that a database of narcs will be compiled, and inevitably, this database of narcs will be hacked. Millions of Americans will be exposed as poseurs — a social problem tragically immune to disruption.

Jamie Lauren Keiles is a writer in New York.



Policing With No Tickets

BY GARETH COOK



The temptation is the greatest on nights when the evening rush seems to congeal around the car, and she just wants to be home. She waits until she has left downtown (too many traffic towers), and then, with a few taps to a screen, she goes for it. Chinese software hacks come well recommended, and it's soon clear why: The car picks up speed and begins to weave through the slower traffic — pleasingly aggressive but more sure in its lines, with less lurching, than the typical Russian black-market goods. She returns to her movie, but before long she hears a chime and a grating alert: “Traffic ticket assessed.” She spots a police car speeding past, a quad drone fixed to the roof, as her own vehicle reverts to

its factory settings and rejoins the docile march of the lemmings.

In the coming world of ubiquitous self-driving, it will just be you, the open road and the vast apparatus of the nanny state. Cars won't readily violate traffic laws and may well be legally required to report on their owners. Ignore that burned-out headlight for too long, and the overnight software update may include a virtual boot.

Traffic tickets bring in billions of dollars annually, so all those well-behaved cars will have an economic impact. Governments that have historically viewed traffic citations as an extractive industry (Ferguson, Mo., say, or the State of California) will have no choice but to find alternatives. Far more consequential, for

both the police and their communities, will be the death of the routine traffic stop. The Supreme Court has ruled that law enforcement may stop any car, whatever its true motive, as long as an infraction is observed. Human drivers can't get far without breaking the letter of the traffic law, so the pretexts come easy. If officers then spot a dozen laptops stacked on the back seat, they can ask questions. Yet this broad, virtually unchecked power to stop has led to charges of racial profiling. (A recent linguistic analysis of bodycam footage from Oakland, Calif., for example, concluded that officers spoke “with consistently less respect toward black versus white community members.”) With pretexts largely automated away, these kinds of interactions will be rare. “The self-driving car,” says Elizabeth Joh, a professor at the U.C. Davis School of Law, “will come to be seen as a civil rights issue.”

The police will have lost an important investigative tool, but the government will have gained new surveillance possibilities. Cars will sweep up vast amounts of data about their surroundings and their occupants, including 24/7 GPS trails. (An important Fourth Amendment case being heard this fall, *Carpenter v. United States*, will decide whether the government needs a warrant to gain access to cellphone locational data, setting a precedent that could apply to cars.)

Another potential target is the pedestrian. In the first part of the 20th century, manufacturers lobbied to make “jaywalking” a crime, so the new horseless carriages could cruise along urban streets relatively unimpeded. The pedestrians of the future, emboldened by the fact that self-driving cars are sure to stop, could cause havoc. No worries, though: Facial-recognition technology is coming along nicely, and the automotive industry will be, if anything, even more powerful. Look for today's complaints about speeding tickets to be replaced by stories of “jaywalking traps” and pitiless fines for a second offense.

Gareth Cook is a contributing writer for the magazine. His last article was about cancer.

Aquacars

BY JENNIFER KAHN



Looking back at the decades when the autonomous car was developed, you may find it hard to believe that its engineers imagined that it would stay landbound. All along, sea levels continued to rise, gradually overwhelming the sea walls that many coastal cities built as protection and flooding the (now absurdly named) ground floor of apartment and office buildings.

Rather than simply abandon these buildings, though, many residents chose to stay — fueling a demand for autonomous aquacars and, as that technology improved, for mobile aquahomes. This became especially true after the successful completion of the *SeaOrbiter*, a floating laboratory originally designed for oceanography research. Elegant and semisubmersible, the *SeaOrbiter* acted as a kind of prototype for local offshore living — and the rise of aerial drone delivery, originally pioneered by Amazon, made the challenge of resupplying straightforward.

Unfortunately, hackers quickly figured out how to hijack the aquahomes' navigation system — first by disabling it and then with programs that directed vessels to floating “chop shops” run by roving gangs of ship-breakers. Piracy rates dropped only after huge kelp growth, driven by a mix of ocean warming and overfishing, rendered the submerged communities as unnavigable by aquacars as they had been by roadbound ones.

Jennifer Kahn last wrote for the magazine about the YouTube series “Primitive Technology.”



The End of Roadkill

BY MALIA WOLLAN

The nearly 264 million vehicles that people are driving over four million miles of American public roads these days add up to a kind of superspecies: a fast-moving predator that leaves its kill to rot on the side of the road. But once they are equipped with 360-degree-sensing technology

that can see farther than the human eye and react more quickly, self-driving cars will — at least theoretically — have significant ecological impact. “If we don’t kill animals with our vehicles anymore, are we willing to live with them in closer proximity to us?” says Patricia Cramer, a wildlife researcher who works with state transportation departments on roadkill issues. “Because that’s what’s going to happen.”

The animals most imperiled by cars are top predators like the Florida panther. Vehicles are responsible for 59 percent of all known panther deaths recorded in the state since 1981; just last year, a record-breaking 34 panthers — about one-fourth of the estimated population — were killed on the state’s roads. Most panthers are struck at night, when human vision is particularly poor, but long-distance infrared cameras can pick up a warmblooded feline

body in the dark, far beyond the range of headlights. Panthers able to cross roads safely could spread out of the cramped confines of Florida’s southern tip, move north into the Okefenokee Swamp and then farther into Georgia on their way to eventually repopulating the Southeast.

There is a concept in ecology called the trophic cascade, essentially the ripple effect on other animals when a top species vanishes. Over hundreds of years, humans methodically killed off predators like wolves, pumas and grizzly bears. Now, in many places, human drivers have become, albeit unintentionally, the top predator. Every year in the United States, there are an estimated 1.5 million deer-vehicle crashes. If self-driving cars manage to give deer safe passage, the fast-reproducing species would quickly grow beyond the ability of the vegetation to sustain them. “You’d get a lot of starvation

and mass die-offs,” says Daniel J. Smith, a conservation biologist at the University of Central Florida who has been studying road ecology for nearly three decades. Species like raccoons and Virginia opossums will most likely see population explosions. “There will be deer in people’s yards, and there will be snipers in towns killing them,” Cramer says.

This rewinding will be largely accidental, of course. Engineers will program cars to prioritize human life and property, making it far more likely they will stop for a moose than for a sparrow. Just how deferential they are toward wildlife will depend on human choices and ingenuity. For now, the heterogeneity and unpredictability of nature tends to confound the algorithms. In Australia, hopping kangaroos jumbled a self-driving Volvo’s ability to measure distance. In Boston, autonomous-vehicle sensors identified a flock of sea gulls as a single form rather than a collection of individual birds. Still, even the tiniest creatures could benefit. “The car could know: ‘O.K., this is a hot spot for frogs. It’s spring. It’s been raining. All the frogs will be moving across the road to find a mate,’” Smith says. The vehicles could reroute to avoid flattening amphibians on that critical day.

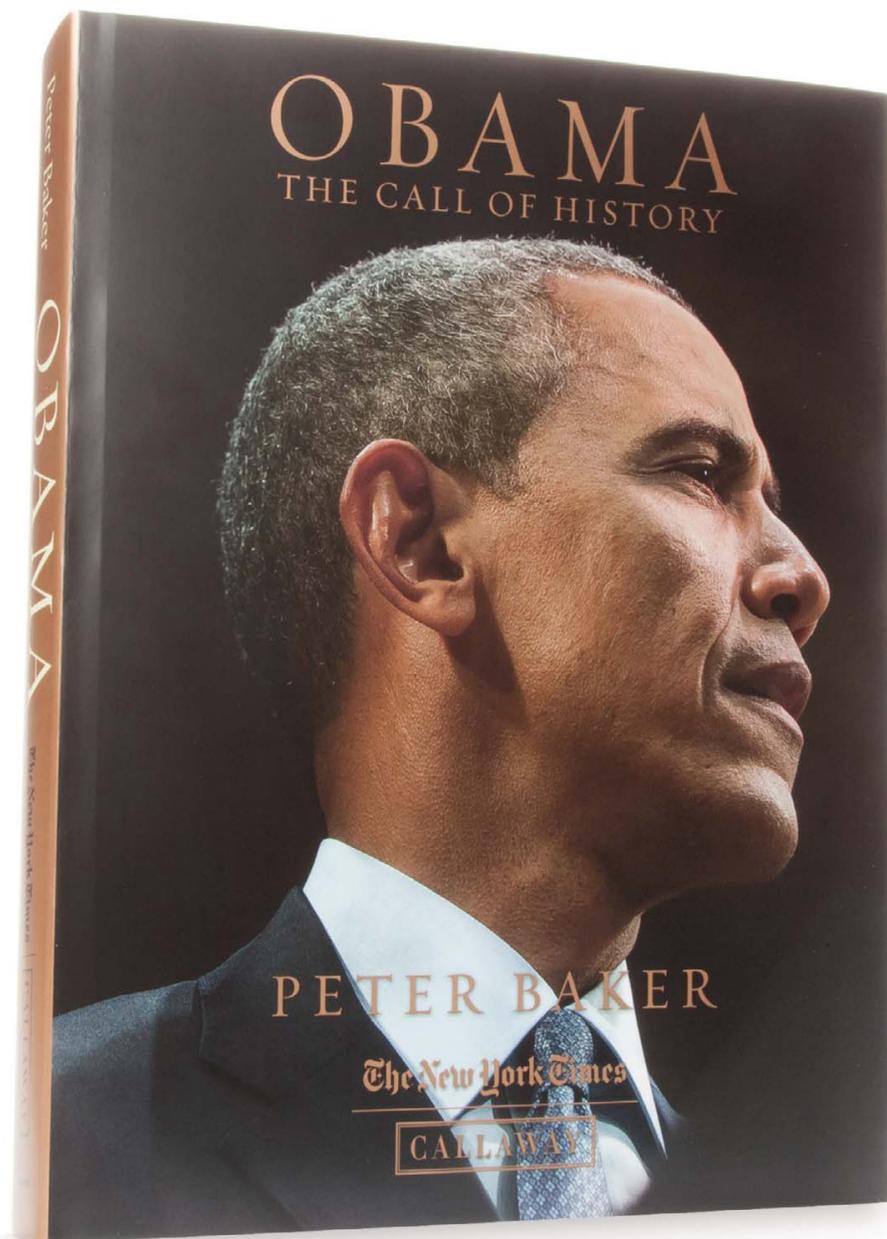
But for that to happen, the people making and buying the cars would need to regard them and the roads not just as a mode of transport but also as part of a vast and intricate ecological web. So far, most humans don’t seem particularly inclined to this kind of systems thinking. It is more likely that a surge in animal populations will be just another unintended consequence of a technological shift — much like social-media sites becoming platforms for publishing fake news or, for that matter, the internal-combustion engine contributing to the suffocation of the planet that might eventually wipe out humans and animals alike. We tend to get caught, ill prepared, in storms of our own making. If one thing seems certain about the autonomous car, it’s that we will go full speed ahead with it, even if we haven’t entirely thought through the consequences. ♦

Malia Wollan is the Tip columnist for the magazine.

OBAMA

THE CALL OF HISTORY

PETER BAKER



A vivid and in-depth illustrated account of the Obama presidency by Peter Baker, the chief White House correspondent of The New York Times.

“The presidency of Barack Hussein Obama was all about hopes — those that were realized and those that were dashed.” —From the author’s Epilogue

“An elegant and evocative look back at the Obama years as history... by one of the most astute observers of the modern presidency.” —Michael Beschloss

“A compelling first look at a consequential presidency that will be studied forever... and here is where we will all start that conversation.”
—Jon Meacham

“Masterfully written and stunningly illustrated.”
—Douglas Brinkley

WITH MORE THAN
180 PHOTOGRAPHS AND GRAPHICS

The New York Times

CALLAWAY

For Elon Musk, autonomous driving is just a pit stop on the road to a better planet.

Can his company survive long enough to get there? BY JON GERTNER PHOTOGRAPHS BY CHRISTOPHER PAYNE

WHAT

SEES



WACUN-0000027641-S

WACUN-0000027641-O

WACUN



miles east of Reno, Nev., where packs of wild mustangs roam free through the parched landscape, Tesla Gigafactory 1 sprawls near Interstate 80. It is a destination for engineers from all over the world, to which any Reno hotel clerk can give you precise, can't-miss-it directions. The Gigafactory, whose construction began in June 2014, is not only outrageously large but also on its way to becoming the biggest manufacturing plant on earth. Now 30 percent complete, its square footage already equals about 35 Costco stores, and a small city of construction workers, machinery and storage containers has sprung up around it. Perhaps the only thing as impressive as its size is its cloak of secrecy, which seems of a piece with Tesla's increasing tendency toward stealth, opacity and even paranoia. When I visited in September, a guard at the gate gave militaristic instructions on where to go. Turning to my Lyft driver, he said severely: "When you complete the drop-off, you are not to get out of the car. Under any circumstances. Turn around and leave. Immediately."

To hear its executives tell it, Tesla is misunderstood because it is still perceived as a car manufacturer, when its goals are more complex and far-reaching. But at least some people have bought into these grand ambitions. This summer, Tesla's stock-market valuation at times rose above those of Ford and General Motors, and its worth exceeded \$60 billion. It did not seem to matter to investors that the company had never made an annual profit, had missed its production targets repeatedly and had become enmeshed in controversy over its self-driving "autopilot" technologies, or that Tesla's chief executive, Elon Musk, had conceded that the value of his company, of which he owns about 22 percent, was "higher than we have the right to deserve." Tesla was a headlong bet on the future, a huge wager on the idea of a better world. And its secretive Gigafactory was the arsenal for a full-fledged attack on the incumbent powers of the car and fossil-fuel industries. The factory would help validate Musk and his company's seriousness about leading humanity's turn to greener technologies, with a vision now encompassing solar roofing tiles and battery packs for home and industry. Most crucial, it involved producing millions of Tesla cars and trucks, all of which would be sleek, electric and self-driving.

If ambitions were all it took, Tesla would be crowned the colossus of the global car industry. But rapidly accelerating new technologies

have brought uncertainty as well. Automakers are encountering three destabilizing forces all at once: automation, electrification and sharing. And sizing up which companies will be the winners and losers in their wakes is in no way obvious. In terms of self-driving cars, it seems likely that long-established companies — General Motors and Ford, as well as BMW and Audi — will benefit from their substantial reserves of cash and deep manufacturing experience. Because these automakers can invest deeply in research (and spend hundreds of millions of dollars to buy start-ups), they can remain competitive with companies less inherently cautious, like Tesla and Waymo, the spinoff of Google's self-driving projects.

Tesla's goal has always been focused on going green, rather than creating the driverless future. (Its mission is emblazoned on its factory walls: "To accelerate the world's transition to sustainable energy.") Yet as the automobile industry settles on the consensus that self-driving cars are coming — their promise to improve safety and to help ride-sharing replace car ownership for many Americans propels their inevitability — Tesla finds itself in the midst of a contest to do both. This set of challenges should be enough for any company, especially one led by a chief executive whose time is compromised by other business commitments as a founder of a rocket company (SpaceX), a new tunneling operation (the Boring Company), a company planning a human-computer interface (Neuralink) and a nonprofit focused on the dangers of artificial intelligence (OpenAI). But Tesla has given itself a few others too. One is to essentially reinvent modern manufacturing processes at the Gigafactory. Yet another is to create the first mass-market electric car ever. In the meantime, a company that has never made much profit needs to somehow figure out how to do so — that is, to put itself in the black before financial losses and missed deadlines curdle any hope that Tesla inspires, among customers or stockholders, into skepticism.

Four hundred possible sites all over the western United States were winnowed down to this Nevada location. I hopped into a Chevy Suburban at the Gigafactory with several Tesla employees to take a look around. We drove through an expansive parking lot and up a steep hill so we could overlook the sprawling building and commotion below. The Gigafactory is often described, somewhat reductively, as a plant where Panasonic, a large tenant within the space, manufactures customized lithium-ion batteries that Tesla then installs in its products. Such an enormous plant allows for long production lines and economies of scale, which company engineers believe will help them lower significantly the price of the batteries, and thus the price of electric cars. The logic within Tesla is that only by "scaling up" — making billions of cheaper batteries for millions of cars — can it have an actual impact on our worsening pollution and increasing amounts of carbon dioxide in the atmosphere. The Gigafactory had to be big, Musk noted at its opening in July 2016, "because the world is big." But the plant's utility is actually in the sum of countless small improvements. As one Tesla executive involved in its design told me, the goal here was not only to minimize the movement of materials like lithium and cobalt but also to shorten the path of every *molecule* that moves through the plant. "Because the further a molecule needs to travel," he said, "the more cost gets added into it. We actually think of it in terms of molecular distance."

Still, the Gigafactory is considerably more than a battery factory: It's the physical embodiment of various technological breakthroughs the company — which just manufactured its 250,000th car — is trying to bring to its cars and energy-storage systems. Tesla makes motors here for its new Model 3 car, for instance, which are then trucked to its assembly plant in Fremont, Calif., 240 miles away. When we went inside, after a labyrinthine walk through offices and up and down stairways, we reached a rapidly moving automated factory line, where batteries were being installed into Powerwalls and Powerpacks — the residential and industrial units that store energy collected from solar panels (or any



electrical generator). Later in the month, devices like these would make their way to Puerto Rico, where Tesla rebuilt the power infrastructure for a children's hospital, and southern Australia, where the company is involved in a vast public project to shore up the country's electrical grid. "We think of this building as a product, because it is a product," my guide told me as we walked alongside a production line. Every machine had been scrutinized, every inch mapped out, every efficiency contemplated. Tesla had taken the highly unusual step of setting up a separate entity to take full control of the building's design, engineering and construction, reflecting Tesla's D.I.Y. ethos to achieve levels of vertical ownership and quality control that its executives believe are unreachable otherwise. The company had even concocted its own Tesla blend of coffee to serve near its cafeterias. "If we cannot get exactly what we want from the world," one executive told me, "then we have to go do it ourselves."

Tesla's grand plans in many respects depend on how much innovation the company can bring to the process of battery making. If the Gigafactory succeeds in reducing costs — one battery-industry analyst, Sam Jaffe, the director at Cairn Energy Research Advisors, told me he thinks the company should be able to drive down the price of its cells by 30 percent — multiple dividends will accrue to Tesla. Cheaper batteries mean more than cheaper cars. They mean Tesla can put larger battery packs into cars for the same cost, increasing the vehicles' range, power and appeal compared with the competition. At the same time, they could make its home energy-storage systems more efficient. Tesla could also gain an advantage in the race to produce autonomous vehicles, or A.V.s. The electric vehicles, or E.V.s, that Tesla wants to make autonomous have zero emissions. If self-driving cars go on rotation, say, in Uber and Lyft fleets, they could run 24-7, possibly leading to more cars on the road. "One of the concerns about automation is that it's going to drastically increase the

miles we drive," Stephen Zoepf, the executive director at the Center for Automotive Research at Stanford, told me. "So if we expect as a society that we're going to be driving a lot more, we obviously want to mitigate the environmental impact."

A welding robot and an employee at Tesla's assembly plant in Fremont, Calif. Opening pages: Robots applying adhesive and welding seams on the Model X and Model S.

'If we cannot get exactly what we want from the world, then we have to go do it ourselves.'

At the Gigafactory, J.B. Straubel, a Tesla founder and the company's chief technology officer, recounted the plant's origin story. In 2012, he did a back-of-the-envelope calculation and realized that if Tesla were to sell something on the order of 500,000 cars a year, it would require the world's entire output of lithium-ion batteries at the time. "We realized, holy crap, this means we need a huge factory," he said, "because there was no way to do this just by putting in an order with some cell company and have them ship a few more." His projections were not far off. When we met in September, orders for the Model 3, which began production in midyear and has been billed as the company's first mass-market car, were around 455,000 through July, suggesting that the demand for E.V.s is far larger than any of the traditional automakers ever imagined. In the future, Straubel told me, Tesla plans to put up many more Gigafactories around the world, "ones that are actually quite a lot bigger than this one" — and it would construct those itself too. "This isn't just a big building that's full of equipment," he added. "There's this idea here of the machine that builds the machine, and it's really true. This place is the embodiment of that."

The impression he wanted me to have, I think, was that Tesla, once it gets this prodigious machine humming, will become robotically unstoppable at cranking out smaller machines, a great big clean-energy perpetual-motion device. At the same time, the company's executives,

from Straubel and Musk on down, were urging potential customers not to view each Tesla product in isolation but as parts of an ecosystem. The Tesla customer could soon use Tesla solar roof tiles during the day to charge up a Tesla Powerwall unit, filled with Gigafactory-made batteries — at night the Powerwall could in turn recharge the Tesla sedan. Perhaps the customer very much liked to drive? In that case, he or she might occasionally stop at one of the hundreds of Tesla "supercharger" stations in cities or along highways. Or maybe the owner didn't like to drive at all and preferred to be driven automatically. Tesla would soon straddle our peculiar moment, the transitional era where humans begin to take their hands off their machines. "Every car made since October of last year," Musk promised in early August, "is capable of full autonomy, we believe."

The day after I toured the Gigafactory, I visited Tesla's California headquarters in Palo Alto to see Doug Field, a top executive



involved with the Model 3. Its price begins at \$35,000, which gets you an average range of 220 miles on a full battery charge; a model with a larger battery pack (and a range of 310 miles) begins at \$44,000. Even that price is a significant step down for the company, whose other cars' most basic configurations start at about \$70,000. I had driven from Reno to Palo Alto in a rented Tesla Model S valued at about \$145,000; it was a four-hour trip, not including a 40-minute stop at a Tesla recharging station in Vacaville, Calif., and with the car's neck-breaking acceleration it seemed the drive could have taken half that time but for speed limits. As the company's flagship vehicle, the Model S is outfitted with several large LED screens but still has the feel of a conventional luxury car. The smaller Model 3 is a different machine altogether — spry and strikingly austere. One large touch-screen in the center of the dashboard essentially controls all the car's driving and interior settings, while also monitoring the battery charge. When I arrived in early September, the first Model 3s had just come off the assembly line, and Field, a rangy engineer who spent a good part of his career at Apple, met me in front of the offices in a metallic blue model. He slid into the passenger side and invited me to take the wheel. "I'll give you a quick orientation," he said, "and then we'll drive off."

Field quickly showed me the controls. There weren't many except for a few dials on the steering wheel. The screen to its right served as the car's dashboard. "This looks forward to an era of autonomy," Field explained, "but it's also simpler and easier to manufacture." That meant cheaper too, which was crucial: Tesla had concluded that every dollar saved on the cost of making the car would mean 100 more families could buy it in a year. As we drove through Palo Alto, the car was nimble and responsive, with the same kind of leaping acceleration that characterizes the Model S. But it took some time to get used to checking the screen to my right for my speed and autopilot settings. Field told me his team had concluded that it would be natural and intuitive for a younger generation. "It's interesting when you put young people in the car," he said. "This is the way all kids navigate technology." It's also possible that the kids might do more navigating, or giving the car orders, than driving. Franz von Holzhausen, Tesla's design chief, later told me that in creating the car's interior, he faced the question of making a car that was affordable and stylish but also relevant for a future era. There was vigorous debate within the company about what to do if the Model 3 became truly autonomous. As time went on, von Holzhausen's group reasoned, this car would be driven less and would be driving more. Thus the decision to jettison dials and controls made sense, because the need for driver information would be reduced, and the central screen could mark routes and arrival times and double as an entertainment center. Those would be the essential tools. Or, as von Holzhausen put it, "The screen then became the hero of the vehicle."

All of Tesla's cars, including the Model 3, come with cameras and sensors; the sensors are small radar and ultrasonic devices situated around the car's exterior that could enable it, presuming the right software is eventually developed, to become self-driving. Because each Tesla car maintains a cellular connection, over-the-air improvements dispensed by the company are a regular feature — tweaking acceleration or braking capabilities through uploaded instructions, for instance. Sometimes the extent to which the company can improve or alter its cars' performance, even years after they left the factory, can be startling or unsettling, as was the case when Tesla temporarily extended the battery range for some drivers fleeing Hurricane Irma in Florida this summer. Self-driving, which Field assured me would ultimately come to pass with the right software and which Musk has repeatedly promoted to investors and customers, would allow Teslas to become something much more than they are. In the parlance of the Society of Automotive Engineers, which has quantified the capabilities a car must have to be considered self-driving, the vehicles will have nearly attained Level 5. This level denotes a safe and fully autonomous car that can operate in any place, and any conditions, without a driver.

'There's this idea here of the machine that builds the machine, and it's really true. This place is the embodiment of that.'

At the moment, Teslas are at Level 2. Their cameras, sensors and software support a more modest capability known as "enhanced autopilot," which costs an additional \$5,000 in a new Model S or Model 3. In certain road and weather conditions, the cars can regulate speed and braking in traffic, steer automatically, change lanes and parallel park autonomously. By some industry rankings, these features now help make Teslas among the safest cars on the road. But following the deadly crash of a Model S driver who was using autopilot in Florida in May 2016, the company reconfigured what the cars permit. When I tried the automated steering on my Model S during the drive from Reno to Palo Alto, for instance, the car chimed frequently in distress and warned me through a dashboard notice when I took my hands off the wheel for a few seconds. I'd been informed that if this happened three times, the car would slow down, stop and rescind my autopilot privileges altogether. I didn't push it. Clearly, the car — and Tesla, too — still needed its driver.

Whether the current fleet of Teslas can become A.V.s is not merely a technical question for the company; it may prove crucial as Tesla struggles to become a major automaker. In 2006, when Musk began to articulate his aspirations for Tesla publicly, he posted what he called his "Master Plan" on the company's blog. He wrote that Tesla would transition from making an expensive electric sports car built in small numbers to making a luxury electric vehicle that expanded its manufacturing competence and market share before ultimately entering the electric mass market. The money from one project would be used to fund each successive project. And the larger idea was not to sell cool cars, or even fast cars, but to hasten the transition of automobiles from gas and diesel to electricity. Steve Jurvetson, an early venture investor in Tesla who now sits on its board, told me that there wasn't much talk of a self-driving future at the start. "I don't recall a discussion of autonomous vehicles and driving being part of the original pitch of Tesla," he said. "It was a big-enough issue to prove that an electric drive train could be a success." As he and Musk knew, there had not been a start-up American car company that had succeeded in nearly a century.

In the summer of 2016, Musk updated his vision for the company — "Master Plan, Part Deux." In the decade since Part 1, the acceptance of electric vehicles had grown to the point where some traditional carmakers, in a surprising turn, were beginning to speak of an inevitable transition to an era when all models were battery-powered. Entire countries (like China) and enormous markets (like California) were also considering eventual bans on internal-combustion engines. As E.V. technology seemed ascendant, a variety of factors outside the auto industry were creating real potential for self-driving vehicles: great gains in computer-processing power, cheaper



hardware sensors, better mobile connectivity, advances in artificial intelligence and enhanced mapping software. In his updated master plan, Musk stated that every Tesla would now have self-driving capabilities and that the application of “fleet learning” — a variation on machine learning — would help the company someday deliver a car that was 10 times safer in self-driving mode than when controlled by a human.

Musk also explained a new fundamental goal of the company. Tesla, he said, wanted to “enable your car to make money for you when you aren’t using it.” In other words, any new Tesla could in due time be part of a sharing network, able to taxi strangers around while its owner worked, slept or did whatever. Most Americans’ cars stay parked about 95 percent of the time. A Tesla would not. In the same way that Tesla’s electric drive train made the American car more efficient, the Tesla network would make the total utilization of the vehicle more efficient, too.

App-based sharing networks for cars already exist: These companies — Turo and Getaround, for instance — are different from, say, Zipcar, because they depend on peer-to-peer communications to arrange for rentals. In essence, they function like mobile Airbnbs, and in some cases have drawn the ire of users in the wake of driver crashes and insurance issues. A Tesla network would push this concept much further, involving perhaps hundreds of thousands or millions of cars, all of them already connected to the internet. Yet such a business network, one Tesla executive told me, most likely wouldn’t succeed unless Tesla’s cars were fully autonomous. Any concerns about insurance and lending a car to a risky driver would disappear, he argued, if autonomous driving proves to be much safer than manual driving. Just as important, autonomy makes irrelevant the problem

of getting the car to where it’s needed next — it can be sent wherever it needs to go via mobile app. What’s crucial here is that the Tesla network, if it becomes functional, can defray the cost of an electric car like the Model 3, which is billed as Tesla’s affordable car but can easily surpass \$50,000 with various options. If your car is making money for you when you’re not using it, it effectively becomes a tool that uses the virtues of A.V.s to promote the market adoption of E.V.s.

Over the course of several months, I often asked people at Tesla, as well as those working on autonomous technologies elsewhere, how far away the self-driving future might be. There was no solid consensus beyond somewhere between two and five years. I tended to believe that the timeline might extend much further and would depend on how tightly we regulate such vehicles and how we agree to define autonomy. Does it mean interstate driving on a sunny day? Or driving within a dedicated area on city streets? Is it a Level 5 overnight trip through heavy rain from Boston to Washington? A driverless taxi pickup on a crowded street under partial construction — orange cones, backhoes, chaos — as a nightclub lets out? Part of the debate concerns hardware and whether the collection of sensors that automotive engineers now build into their A.V.s can collect enough data to create a fully autonomous car. These sensors generally include radar, cameras and Lidar, the expensive laser-based technology that Tesla has so far declined to use. Many other A.V. researchers consider it essential. Lidar uses light waves, rather than radio waves, to map and “read” a car’s environs.

Drive units for the Model X and Model S at the Fremont plant.

Musk has promised that before the end of this year, a Tesla vehicle will drive itself coast to coast



‘After five years, Tesla will become the Apple in the industry. . . . Tesla will be the iPhone of cars — more elegant, better designed. Maybe even safer.’

completely on autopilot. A number of competitors — especially Waymo and General Motors — seem to be closing in on similarly ambitious goals. But it’s worth noting that no Level 5 car has ever been publicly deployed, and it’s doubtful one even exists; the coast-to-coast trip on autopilot, Musk suggested, wouldn’t yet be an instance where a driver could, say, go to sleep at the wheel. What’s more, no Level 4 car, where the vehicle is self-driving under certain weather and geographical conditions, has been put in regular service, either. In fact, while driver-assistance tools like autopilot can greatly reduce crash rates, no company or researcher has ever demonstrated that a robotic automobile can consistently operate in the everyday world more safely than a car with a human driver.

An executive close to Musk told me that his boss believes that creating a true A.V. is a “solvable” problem, one probably less difficult than others he has encountered in various business endeavors — for instance, creating cheap, reusable rockets for SpaceX, his other major company, or pushing Tesla’s Model S to such unlikely success. This may indeed prove true. But unlike other tech innovations, the development of driverless cars cannot count on something like Moore’s Law, which has projected a doubling of computing power at regular intervals and has allowed Silicon Valley entrepreneurs a clear window into the future. Based on conversations with engineers on the A.V. front lines, the most difficult problem is rigging cars with sensors and software that can take a rich, clear, picture of every element in the surrounding environment — people, bikes, signs, obstacles — and then algorithmically choreograph the future.

This challenge is as arduous for Tesla as it is for engineers everywhere working to solve it. And yet the exigencies of Tesla’s business model add an additional layer of complexity. To reach its sustainability goals and become profitable, the company must make lots of cars that are electric and sporty and increasingly affordable; meanwhile, to prepare for the future, Tesla has to build cars that eventually won’t need us. Some of the most experienced researchers working on A.V.s believe that these are two separate and possibly irreconcilable ambitions and that it makes more sense to focus on a pure driverless car, even if it proves to be a very expensive proposition at first, rather than follow Tesla’s incrementalist policy, which would involve rolling out software on a regular basis until the driver does less and less and finally nothing at all. With the second approach, one Silicon Valley engineer said, “the market pressures that are going to be applied to those technologies mean that you’re not going to climb up the safety and reliability curve” to build a true A.V. Keeping the vehicle affordable is in constant tension with making the vehicle autonomous. Musk’s optimism alone can’t change that.

The first company to succeed at A.V. technology won’t necessarily capture the market in a way that, say, Facebook did with social media. Tesla might have time to make its current strategy work, and it could be that what

matters more in the near term are the company’s advantages in batteries and electric vehicles (assuming it can manage the transition to mass-market production). Jurvetson, the early Tesla investor, told me that he thought the company with the best artificial-intelligence systems would come to dominate the auto business of the future. But he did not put a time frame on it, and he did not see it as a winner-take-all prospect. Vivek Wadhwa, a prominent tech entrepreneur and Tesla enthusiast, told me that he sees Tesla’s success prefigured in the smartphone market. “After five years, Tesla will become the Apple in the industry,” he predicted, based on the fact that it is best positioned to capitalize on the potential combination of E.V. and A.V. technologies. But Wadhwa pointed out that phones running on Google’s operating system, rather than Apple’s, are the ones that dominate the world. “Musk will be exactly where Tim Cook will be,” he said. “Tesla will be the iPhone of cars — more elegant, better designed. Maybe even safer.”

Musk declined my interview requests over the course of several months. By early November, the number of Model 3 cars coming out of the factory had fallen far short of what Musk had promised, the company’s stock price had taken a nose-dive and there appeared to be serious software and robotic glitches at the Gigafactory. Musk was said to be too busy to talk, which did not always square with his social-media postings: jokes, poems, photos of tunnels he was digging, links to stories about the dangers of artificial intelligence and, in one instance, footage of a camping excursion on the roof of the Gigafactory.

The company’s evasiveness and secrecy extended to self-driving cars, a subject it was unwilling to discuss in any detail. One Tesla engineer I spoke with, who works on autopilot systems, maintained that the company’s camera and sensory hardware will prove good enough to get his team where it wants to go, which as a near-term goal means cars with a self-driving capability that is twice as good as a human driver (rather than 10 times as good, per the second master plan). By November, Musk was telling investors that





Above: A Model S on the assembly line in Fremont. Left: Franz von Holzhausen, Tesla's design chief, sketching at the company's design studio in Hawthorne, Calif.

“self-driving” package (on top of the \$5,000 for “enhanced autopilot”), based on Musk’s assurances that the new cars have all the hardware necessary and will be autonomous once regulations and functional software are worked out.

There’s no clear indication of whether these efforts are on track, and in the past year, several engineers who ran Tesla’s autopilot unit have left the company. In early October, Scott Miller, an executive involved with General Motors’ self-driving efforts, charged publicly that Musk was “full of crap” for claiming that his cars could offer self-driving capabilities with their current hardware. His assertions echo those of some other Tesla critics I spoke with: Without Lidar, or a more expensive hardware approach, Musk’s cars may be at a significant disadvantage. Indeed, several people familiar with the company’s A.V. work viewed its self-driving approach as a perilous one, given that there is no definitive way to predict how long it could take Tesla to satisfy the promises made to customers. In the best case, if A.I. and software breakthroughs ultimately transform cars like the Model 3 into self-driving vehicles, Musk will have pulled off something that perhaps seems impossible today. In the worst case, hundreds of thousands of owners will have cars that won’t achieve the status of true A.V.s and can only hope that the sharing network of the master plan will someday become a reality.

Tesla’s setbacks, Musk noted in November, shouldn’t eclipse the fact that the company has already grown faster by some measures than Ford when it rolled out the Model T in the early 1900s. He takes a longer view

the actual goal was to get the system simply on a par with a human driver and that that might require a more powerful computer in the cars, which Tesla would swap in free if necessary. Some customers have already paid \$3,000 for a Tesla

of his business than Wall Street analysts. In a recent TED interview, while discussing his plans for cities on Mars, he argued that it’s a mistake to assume that technology gets better as time goes on. “It does not automatically improve,” he insisted. “It only improves if a lot of people work very hard to make it better, and actually it will, I think, by itself degrade.” He cited the Egyptian pyramids and Roman aqueducts and how the knowledge to build them was lost for hundreds, or even thousands, of years afterward. The relevance is striking in a time when the federal government would rather subsidize the growth of the coal and fossil-fuel industries than renewable energy and electric cars.

Long before anyone saw Tesla as a legitimate player in the auto industry, Musk also appears to have understood that in taking chances that no established carmaker would, Tesla could be an innovative force to quicken our slow, plodding progress in transportation. Imagine Tesla didn’t exist, Steve Jurvetson told me. “What would the world look like? I have this sinking suspicion it wouldn’t look that different than 10 years ago. A bunch of hybrid cars. A bunch of noise about hydrogen vehicles. You know, I don’t think the world would look anything like today — where entire nations are saying, ‘We’re going to stop making gas cars.’”

The company’s impact, real and potential, is all the more surprising considering that Musk has staked Tesla’s success on the industrial equivalent of a shoestring, lacking the resources of established carmakers. He has used customer revenue, his own wealth, venture capital, bank and government loans, investments by other automakers and the American stock and debt markets to effectively fund a multibillion-dollar research-and-development project. In that way, he has led the industry to the start of a new era. And now his company, hindered by debilitating manufacturing bottlenecks and its extravagant promises of self-driving, is poised to find out whether, in laying the groundwork for an electric and autonomous future, he took one risk too many. ♦

LUXURY *Developments*



Waterline Square
Rendering: Noe & Associates with The Boundary

From a major development in South Florida to several residential construction projects already under way in Manhattan near the Hudson River, several noteworthy luxury towers are set to open their doors in the coming months.

WATERLINE SQUARE

As the final piece of the 25-year Riverside South master plan comprising 77 acres of waterfront land at the nexus of the Hudson River, the Upper West Side and Midtown Manhattan, Waterline Square will begin closings the second half of next year. GID

Development Group, a national real estate organization, has commissioned three world-renowned firms — Rafael Viñoly Architects, Richard Meier & Partners Architects and Kohn Pedersen Fox Associates — to design three luxury residential buildings as part of the five-acre development between West 59th Street to 61st Street. In all, Waterline Square will feature 263 luxury condominium residences ranging from one- to five-bedroom layouts on the 20th floor and higher in each glassy tower, providing sweeping views of the Hudson River and Manhattan skyline that stretch down to the Statue of Liberty.

One Waterline Square by Richard Meier will feature interiors by international designer Champalimaud, while Two Waterline Square by KPF has interiors designed by the boutique hotel and hospitality duo Yabu Pushelberg.

Three Waterline Square by Rafael Viñoly, surrounded by green space and adorned with a faceted and angled facade, is outfitted with interiors designed by Groves & Co.

Connecting One, Two and Three Waterline Square is the Waterline Club, located below the three-acre tree-lined park at the heart of the development, with indoor amenities designed by David Rockwell's hospitality group. In all, Waterline Square will offer more than 100,000 square feet of sports, leisure and lifestyle amenities, including an indoor tennis court, squash court, 30-foot rock climbing wall, indoor half-pipe skate park, golf simulator, full-court basketball, indoor soccer field and a fitness center with Pilates, boxing and yoga/barre studios.

Spa and swim offerings include a 25-meter, three-lane lap pool with a separate children's pool, hot tub, steam rooms and saunas. Leisure offerings range from an enclosed catering kitchen, party room, bowling alley, games lounge, cards parlor and screening room to an indoor gardening studio, art studio, music recording studio and video and photography studio featuring AV equipment. A massive 4,600-square-foot children's playroom, designed by Roto Group, and an indoor playroom, washing station and training studio for pets round out the shared amenities.

Beyond that, each individual building at Waterline Square will have its own selection of private amenities for condo residents, including large great rooms with fireplaces, private dining rooms, media and game rooms, salons and billiards lounges, spirits libraries and landscaped terraces with outdoor kitchens.

Finally, the Cipriani family recently announced it will be developing a 28,000-square-foot food hall designed by London-based interior designer Martin Brudnizki.

"We are building not just one building, but an entire five-acre master plan all at once, which allows us to create these very impactful one-of-a-kind amenity spaces, like the new food hall and the Waterline Club," said James Linsley, president of GID Development Group. "The notion that we are not phasing construction, but constructing the plan all at once — including the residences, park and all the amenities — is just not something that others can offer."

Prices start at approximately \$2 million, with the approval of a 20-year tax abatement expected soon. The sales gallery is located at 475 West 61st Street, with Corcoran Sunshine Marketing Group the exclusive sales and marketing agency. For more information, call 212-586-8333 or visit waterlinesquare.com.



FOUR SEASONS

PRIVATE RESIDENCES

FORT LAUDERDALE

A PROJECT BY FORT PARTNERS

A Proud Presenting Sponsor of

FRANK STELLA:

EXPERIMENT AND CHANGE



*Frank Stella, Lettre sur les sourds et muets II, 1974 Synthetic polymer paint on canvas, 141 x 141 x 4 inches
Private Collection, NY © 2017 Frank Stella / Artists Rights Society (ARS), New York, Photo Credit: Christopher Burke*

*NOVEMBER 12, 2017 - JULY 8, 2018
at NSU Art Museum Fort Lauderdale*

Introducing Four Seasons Private Residences Fort Lauderdale, a new oceanfront destination for Four Seasons living.
Residences available from 1-4 bedrooms including furnished and unfurnished options. Prices from \$2M.

+1 (954) 324.2497 - FORT525RESIDENCES.COM



BROKER PARTICIPATION WELCOME.

ORAL REPRESENTATIONS CANNOT BE RELIED UPON AS CORRECTLY STATING THE REPRESENTATIONS OF THE DEVELOPER. FOR CORRECT REPRESENTATIONS, REFERENCE SHOULD BE MADE TO THE DOCUMENTS REQUIRED BY SECTION 718.503 FLORIDA STATUTES, TO BE FURNISHED BY THE DEVELOPER TO BUYER OR LESSEE.

PLANS, FEATURES AND AMENITIES SUBJECT TO CHANGE WITHOUT NOTICE. ALL ILLUSTRATIONS AND PLANS ARE ARTIST CONCEPTUAL RENDERINGS AND ARE SUBJECT TO CHANGE WITHOUT NOTICE. THESE MATERIALS ARE NOT INTENDED TO BE AN OFFER TO SELL, OR SOLICITATION TO BUY A UNIT IN THE CONDOMINIUM. SUCH AN OFFERING SHALL ONLY BE MADE PURSUANT TO THE PROSPECTUS (OFFERING CIRCULAR) FOR THE CONDOMINIUM AND NO STATEMENTS SHOULD BE RELIED UPON UNLESS MADE IN THE PROSPECTUS OR IN THE APPLICABLE PURCHASE AGREEMENT. IN NO EVENT SHALL ANY SOLICITATION, OFFER OR SALE OF A UNIT IN THE CONDOMINIUM BE MADE IN, OR TO RESIDENTS OF, ANY STATE OR COUNTRY IN WHICH SUCH ACTIVITY WOULD BE UNLAWFUL. FOR NEW YORK PURCHASERS ONLY, THE COMPLETE OFFERING TERMS ARE IN A CP-12 APPLICATION AVAILABLE FROM THE OFFEROR. FILE NO. CP17-0076. FORT PARTNERS IS NOT THE PROJECT DEVELOPER. THE PROJECT IS BEING DEVELOPED BY MW LAUDERDALE, LP, A DELAWARE LIMITED PARTNERSHIP, WHICH HAS A LIMITED RIGHT TO USE THE TRADEMARKED NAMES AND LOGOS OF FORT PARTNERS PURSUANT TO A LICENSING AND MARKETING AGREEMENT WITH FORT PARTNERS. FOUR SEASONS PRIVATE RESIDENCES FORT LAUDERDALE ARE NOT OWNED, DEVELOPED OR SOLD BY FOUR SEASONS HOTELS LIMITED OR ITS AFFILIATES (FOUR SEASONS). THE DEVELOPER, MW LAUDERDALE, LP, A DELAWARE LIMITED PARTNERSHIP, USES THE FOUR SEASONS TRADEMARKS AND TRADE NAMES UNDER A LICENSE FROM FOUR SEASONS HOTELS LIMITED. THE MARKS "FOUR SEASONS", "FOUR SEASONS HOTELS AND RESORTS" ANY COMBINATION THEREOF AND THE TREE DESIGN ARE REGISTERED TRADEMARKS OF FOUR SEASONS HOTELS LIMITED IN CANADA AND U.S.A. AND OF FOUR SEASONS HOTELS (BARBADOS) LTD, ELSEWHERE. EXCLUSIVE MARKETING & SALES DOUGLAS ELLIMAN DEVELOPMENT MARKETING. EQUAL HOUSING OPPORTUNITY.

FOUR SEASONS PRIVATE RESIDENCES FORT LAUDERDALE

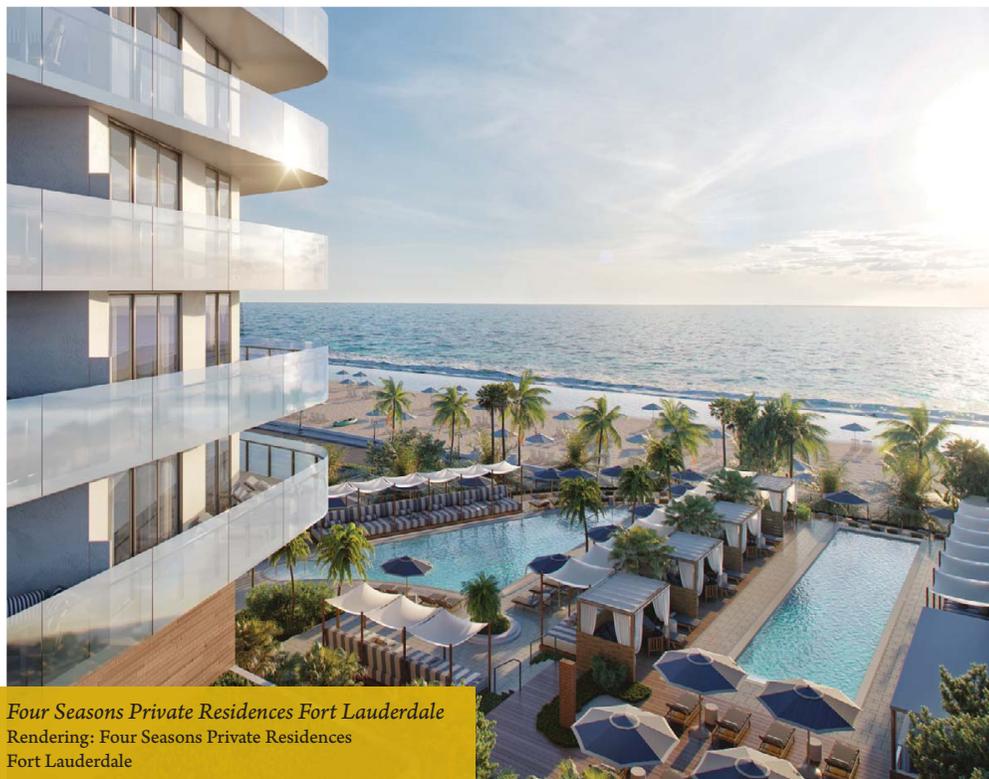
Miami-based developer Fort Partners is developing Four Seasons Private Residences Fort Lauderdale as the centerpiece of Fort Partners' Fort Portfolio in South Florida, which also includes Four Seasons Hotel and Private Residences at The Surf Club in Surfside and Four Seasons Resort Palm Beach. Set on the Atlantic coastline, thirty minutes north of Miami and forty-five minutes south of Palm Beach in prime Fort Lauderdale, the new property will feature 90 residences ranging from one- to four-bedrooms, either furnished (48 in total) or unfurnished (42).

Residences will range from 780 square feet to more than 6,000 square feet, including three grand two-story residences with 20-foot ceilings. The interiors and exteriors are designed by an international team, led by Fort Partners' Nadim Ashi, that includes Tara Bernerd, Kobi Karp, Martin Brudnizki and Fernando Wong. Owners at Four Seasons Private Residences Fort Lauderdale will have privileged access to the Fort Portfolio of Four Seasons properties.

Amenities include a Four Seasons spa and fitness center, oceanfront terrace with two pools and cabanas and a signature restaurant, and all buyers will have access to the services of their own dedicated Four Seasons residential concierge. Services for owners and their families include beach butler, private car and yacht service, plus in-residence butlers, housekeeping and access to the All Seasons program for kids and the use of Four Seasons for Pets.

"With more international flights arriving, world-class yachting and a growing cultural scene, Fort Lauderdale has become a global destination," said Senada Adzem, Global Brand Ambassador for Four Seasons Private Residences Fort Lauderdale. "This development is attracting international attention because of the value the global brand carries with it, and the trust prospective purchasers have in the brand. Four Seasons Private Residences Fort Lauderdale will provide a sophisticated lifestyle in the flourishing city of Fort Lauderdale."

Fort Partners has chosen to be a presenting sponsor of "Frank Stella: Experiment and Change," an exhibition which begins today and will run through July 8 at the NSU Art Museum Fort Lauderdale. The collaboration between Fort Partners and the NSU Art Museum Fort Lauderdale for the Frank Stella exhibition is the result of the lifelong friendship between the artist and Richard Meier. "The developer believes this is a perfect opportunity to capture



Four Seasons Private Residences Fort Lauderdale
Rendering: Four Seasons Private Residences
Fort Lauderdale

the attention of a cultured and sophisticated demographic, ready for world-class luxury in Fort Lauderdale," she concluded.

First occupancy expected by the end of 2019. Furnished residences start at \$2.4 million, with unfurnished residences starting at \$3.1 million. Prices for the penthouse collection range from \$7.5 million to \$15 million. For more information, call 954-324-2489 or visit fort525residences.com.

NINE ON THE HUDSON

Located in West New York along the Hudson River near the New York Waterway ferry to Manhattan and light rail up and down the New Jersey coast, Nine on the Hudson is a 13-story luxury condominium with 278 apartments currently being developed by K. Hovnanian as its premier condominium building on New Jersey's "Gold Coast." The building's tiered design provides exceptional corner views of the New York City skyline stretching from the Verrazano to George Washington Bridges. First occupancy is expected in late February or March, with apartments starting in the \$700,000 range.

The building will feature 31,655 square feet of indoor and outdoor amenity space, including an infinity pool with a hot tub on the third-floor amenity deck, with a host of resort-style services and amenities, including a sunbathing lawn, fitness center, rooftop deck, business center, party room, residents' lounge, 24/7 concierge,

sauna and spa, children's playroom, virtual golf, cold storage, a rooftop fire pit lounge and dining areas with panoramic views.

The one-, two- and three-bedroom apartments, most with balconies or terraces, average 1,475 square feet, with three-bedroom apartments comprising 2,577 square feet. All come with full-height curtain windows, nine-foot ceilings, heated floors in the living area, Bosch washer and dryers and contemporary kitchens with a Bosch appliance package, Thermador refrigerators and Pedini cabinetry.

Located across from Manhattan's 68th Street, the area is seeing a mini-boom in residential construction, bringing shops and services within walking distance. "Walkability it not always so easy in New Jersey, but we offer a truly walkable alternative to suburban living, with a short commute to Manhattan," said Alexander Hovnanian, area vice president of Northern New Jersey for K. Hovnanian Homes. "You have to come to New Jersey to enjoy the best Manhattan views — and our customers understand that our building is just minutes away by ferry from Hudson Yards right across the river, which is already one of the most coveted, and expensive, housing developments in Manhattan. Their apartments start at around \$3,000 per square foot, while ours are around \$700 per square foot. Buyers from all over New York City as well as parts of New Jersey are selling to take advantage of the prices we are of-

91 Leonard
 Rendering: Toll Brothers City Living



fering. They see how easy it is to get here, and they want to be a part of the new emerging market across the river.”

An additional incentive is the 20-year tax abatement rate of 1.1 percent for the first ten years, a considerable savings over the West New York tax rate for home buyers. “The quality of our outdoor space is a real draw, with the views of Manhattan and the river — at a level of finish that we just have not seen in this area before,” added Hovnanian. “Couple that with the tax savings, which makes a huge difference in what you can afford, and you have a compelling value proposition.”

The on-site sales office is located at 9 Avenue at Port Imperial in West New York, New Jersey. For more information, visit khov.com/nine or call 844-230-7459.

91 LEONARD

Toll Brothers City Living, the urban development division of Toll Brothers, Inc., the nation’s leading builder of luxury homes, recently announced the sales launch for 91 Leonard, a new 19-story condominium designed by architects Skidmore, Owings & Merrill (SOM) and Hill West in TriBeCa. Comprising 111 residences close to New York Harbor and the Hudson River between Church Street and Broadway, the ground-up construction building will feature an exterior reflecting the area’s well-known industrial heritage — with dark bronze window frames



Nine on the Hudson
 Rendering: VDP

and terra-cotta fins that reinterpret the classic, layered facades of the neighborhood’s cast-iron warehouses and lofts.

The building’s entry opens into a towering brick-lined vestibule that evokes the feeling of a secret passageway hidden along a European street, with floor-to-ceiling windows that overlook a garden and reflecting pool designed by the Swiss-based landscape architectural firm Enea. The light-filled lobby is finished in whitewashed brick and textured concrete, with a residents-only lounge with a fireplace, billiard table and a secluded nook that opens onto another private courtyard garden and reflecting pool beyond.

“SOM is already prolific in the commercial space, having done some of the most important buildings in the world, including iconic buildings like 1 World Trade Center — and we were eager to work with them on a residential building in Manhattan,” said David Von Spreckelsen, division president of Toll Brothers City Living. “We are fortunate to have a true world-class architecture firm work with us in one of the city’s most valuable residential neighborhoods.”

The full-service building will be attended by a 24-hour doorman and concierge, with amenities including a fitness center, indoor pool, sauna and steam room, children’s playroom, screening room and a rooftop lounge with outdoor fireplace for everyone in the building to experience. “We have a full complement of amenities, which is noteworthy for a 19-story

building,” added David Von Spreckelsen. “We prefer to build smaller, more intimate condominiums of around 100 units or so because they don’t feel overwhelming to our buyers — but still provide the full complement of amenities luxury buyers demand.”

91 Leonard also brings a new affordability to eastern TriBeCa, one of city’s most popular residential neighborhoods. About 80 percent of the residences are priced below \$3 million. “This is a rare opportunity to live in a new-construction building with modern amenities and refined spaces located in a coveted area many buyers find themselves priced out of,” he said. “We are in the eastern part of TriBeCa, a block from Herzog & de Meuron’s newly iconic 56 Leonard, two blocks from the Franklin Street subway stop and not a long walk from Hudson River Park, which has become a true waterfront destination. Our goal with 91 Leonard is to make this very popular area more attainable for buyers, while still delivering the high-design finishes — like kitchen cabinets by Poliform and an appliance package by Gaggenau — coupled with the amenities and lifestyle that our customers are looking for in downtown Manhattan.”

Prices for studios to four-bedroom layouts, with five penthouses, range from \$849,000 to \$11,995,000. The sales gallery is located at 75 Leonard Street, with first occupancy slated for the second quarter of 2019. Contact the sales team at 212-981-8502 or visit 91Leonard.com for more information. ♦

quit their jobs and started Argo AI in November of last year, and in February, with no real product to speak of, and hardly any employees, they announced that they had raised huge sums of money from Ford.

The day before my visit, Salesky made waves with a bombastic post on the company's blog, in which he accused the autonomous-vehicle industry of overselling its progress. "Those who think fully self-driving vehicles will be ubiquitous on city streets months from now or even in a few years," he wrote, "are not well connected to the state of the art or committed to the safe deployment of the technology." It was a rare role reversal — the software engineer throwing up caution flags — and, perhaps, evidence that Ford is trying to stall for time. Officially, Argo is still aiming for Ford's 2021 target, but Salesky waffled on the firmness of that deadline, saying there's a chance a true Level 4 autonomous vehicle could be finished later, or possibly sooner. "It's ready when it's ready," he told me.

Salesky freely admitted that he is playing catch-up. Ford won't share statistics about its self-driving test cars, but public records from California give some sense of what it's up against. Last year, Ford, which does most of its testing in Michigan and Arizona, logged just 590 autonomous miles in the state, while Waymo's vehicles logged 635,867 miles. Argo is also building its code from scratch and doesn't have access to the digital infrastructure that competitors like Waymo and Uber do. "We're not out there trying to tell everyone we're going to be first or beat X, Y or Z company," Salesky said. "The goal is to get to market with something that can scale up."

But, he reiterated, this is a *hard* problem. Driving is a miracle of neurobiological coordination that involves the flawless simultaneous execution of a billion tiny and subtle reflexes, and it turns out that's a more complicated task for a computer than teaching it to play chess or compete on game shows. A self-driving car has to correctly identify and label millions of objects, understand city layouts and traffic laws and operate in a variety of road conditions. It has to be taught to handle everyday driving hazards (high-speed merges) and rarer incidents (objects in the road), as well as issues that would never affect a human driver (a chunk of debris that flies up and knocks out a sensor).

In order to work properly, a self-driving car also has to understand how humans behave. It needs to know the difference between a car that is idling in the right-hand lane (in which case the autonomous vehicle should steer around it) and one that is about to parallel park (in which case the vehicle should stay in its lane, giving the other car some room). It needs to predict

that the jogger running toward the corner will stop for traffic, but that the kid running to chase a basketball might not. It needs to be able to navigate a four-way stop, which in polite parts of the country involves lots of eye contact and you-first hand gestures. "This goes beyond just seeing and understanding the world," Salesky said. "It means understanding what each of the actors in the world is going to do."

In other words, driving isn't just a mechanical task — it's a social act, and in order to coexist with human drivers, self-driving cars will need to develop a level of social awareness that approaches that of a full-fledged A.I. This is why some computer scientists think Waymo is going to be unbeatable. As an Alphabet company, Waymo has access to some of the best engineering talent in A.I., along with Google's enormous data troves and the machine-learning systems that have been trained using that data. In other words, the vast data-harvesting powers that make Google's consumer products so creepy could also make Waymo's vehicles better at navigating the physical world.

But all this obsessive focus on tech elides a much more foundational question about our relationship to cars. Tech companies tend to view driving as a functional problem — get safely from Point A to Point B as quickly as possible — in which the vehicle itself is largely an extraneous variable. A car might begin its life as a Toyota or a Hyundai, but once it's autonomous and on a ride-sharing network, it's just an Uber. Silicon Valley believes that software, not hardware, is what matters to riders, and this will be especially true of self-driving cars — which, at least in early days, will most likely be shared among strangers.

But Detroit has spent decades and billions of advertising dollars persuading us that its mass-produced cars are anything but homogeneous metal boxes — that they carry profound talismanic qualities that transfer to their owners. You can be an F-150 woman or a Mustang man, and those choices signal tribal affiliations that extend far past the act of driving. Ford's challenge, then, is keeping these storied brands alive for the consumers who still obsess over them, while Argo builds the software that will satisfy the car-agnostic city dwellers. It's a tricky balancing act, made even more complicated by the politics of a 114-year-old Detroit manufacturing company lashing its fate to a one-year-old Pittsburgh tech start-up, and vice versa. "They've put a lot of trust in us," Salesky said. "We've also put a lot of trust in them."

The hall connecting the C-suites at Ford's headquarters was a mess when I visited in October: exposed wiring, plastic sheeting hanging from the walls. As I made my way to Bill Ford's office, my P.R. escorts offered an explanation. Parts of the floor were being reimaged as an open-plan creative space, and the chaos had spilled outward. When we reached the end of the hall, Ford welcomed me into his office, a midcentury

wooden cavern with a fish tank built into one wall and a panoramic view of Dearborn along the other. The dreary vista stood in stark relief with the golden-era artifacts in Ford's office: the replica of a 1956-57 Continental Mark II that was designed by his father, William Clay Ford Sr.; a desk that belonged to his grandfather, Edsel Ford.

Bill Ford has been working in the family business for 38 years and spent most of that time as an iconoclast. His interest in "smart mobility" — which amounts to an interest in reducing the number of cars on the road — was until recently considered heretical. But the past few years have vindicated his predictions. He thinks that the coming convergence of tech and transportation could turn Detroit and Silicon Valley into permanent collaborators. He started Fontinalis Partners, a venture-capital fund outside Ford, to invest in mobility start-ups, and flies regularly to San Francisco to meet with entrepreneurs working on transportation-related projects.

"The narrative, probably even two years ago, would have been 'tech companies win, autos lose,'" he said. "What's happened, though, is there's been a realization that we have a lot more intellectual property than the world realized," by which he means celebrated lines like the F-150, along with some proprietary under-the-hood technology that I won't pretend to understand. "Second, we really know how to integrate a lot of what the tech companies have into our vehicles, and we know how to make vehicles as well."

I was struck by how frequently this simple point is deployed at Ford: We know how to make stuff, and making stuff isn't easy. At first, I dismissed it as a naïve attempt to steer a conversation about Detroit's shortcomings back toward its strengths. Apple taught suppliers halfway across the world how to make iPhones with micron-level precision — how hard could it be to slap some metal together and put it on wheels?

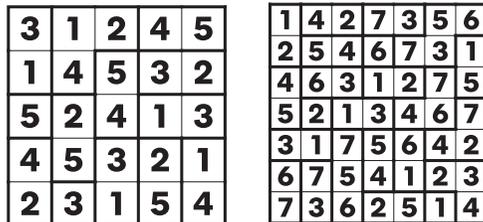
But making cars isn't like making other things. It's a dizzying logistical ballet that involves heavy machinery, grueling labor and countless opportunities for error. It's wrangling union contracts while keeping the line moving. It's paying people enough to ensure that they won't miss a loose bolt and kill someone. It's designing objects that not only work well but also fill a psychological need for buyers. In the end, maybe the self-driving-car race will be decided not purely on technological achievement, but also on these much more prosaic questions — who can make good things and persuade people to use them? After all, the Model T wasn't the first car invented, or the best at the time. But it was accessible and functional and spoke to people's needs in a simple way during a time of confusing technological change. That conversation is about to begin again. ♦

Answers to puzzles of 11.5.17

LANE CHANGES



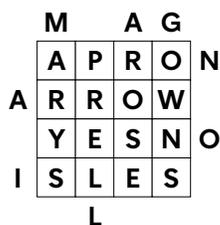
KENKEN



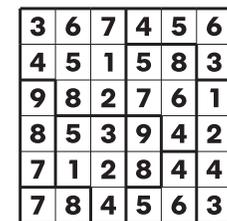
PUNS AND ANAGRAMS



PROJECTORS



BOXING MATCH



Answers to puzzle on Page 78

SPELLING BEE

ARGONAUT, GUARANTOR, ORANGUTAN (3 points each). Also: Augur, aurora, gargantuan, gaunt, grout, grunt, guano, nougat, outgo, outgun, outran, outrun, ragout, rotgut, taunt, trout, truant, turnout, tutor. If you found other legitimate dictionary words in the beehive, feel free to include them in your score.

Would you like to Live Stress Free?
Introducing Svago - redefining Zero Gravity



Special
Holiday
Price!

Feel tension melt away!

- Independently adjustable foot rest & headrest angle
- Wave Heat • One touch Zero Gravity



844-697-8246
Svago.com 844-MY-SVAGO



Holiday Sale! Order before Nov 23rd to receive exclusive offers:
Free Shipping • 90 Days Risk Free • 6 month financing

ROSS SIMONS

celebrating our 65th anniversary of fabulous jewelry



4.00ct. t.w. CZ Bolo Bracelet in Sterling Silver

Bracelet adjusts to fit most wrists with a sliding closure. 16 CZs totaling 4.00 carats (weights are diamond equivalents). Sterling silver box chain. Shown slightly larger for detail.

Only \$69 plus free shipping

Ross-Simons Item #881612

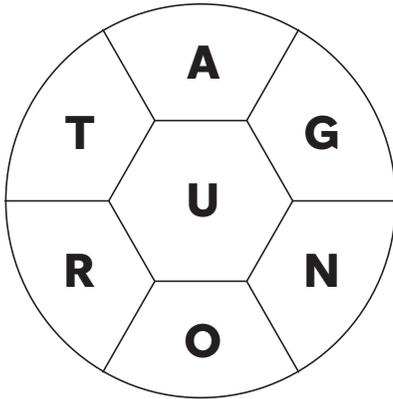
To receive this special offer, use offer code: **GLITTER22**
1.800.556.7376 or visit www.ross-simons.com/GLITTER

SPELLING BEE

By Frank Longo

How many common words of 5 or more letters can you spell using the letters in the hive? Every answer must use the center letter at least once. Letters may be reused in a word. At least one word will use all 7 letters. Proper names and hyphenated words are not allowed. Score 1 point for each answer, and 3 points for a word that uses all 7 letters.

Rating: 8 = good; 15 = excellent; 22 = genius



Our list of words, worth 28 points, appears with last week's answers.

WHIRLPOOL

By Patrick Berry

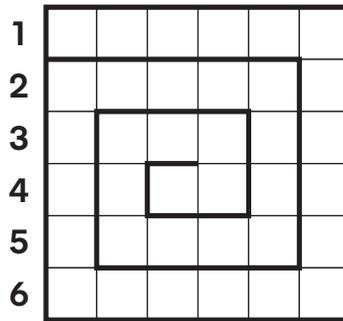
Row answers fill correspondingly numbered Rows. Answers to Whirlpool clues start at the top left corner and spiral inward along the heavily outlined path, one after another.

ROWS

- Surgical implements
- Having long, unkempt hair
- ___ Avenue (one of the two cheapest Monopoly properties)
- From scratch
- Track down
- Kept a leaky boat afloat

WHIRLPOOL

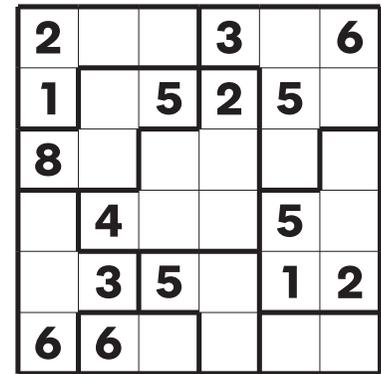
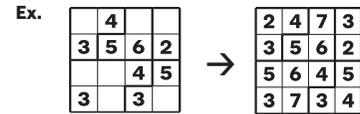
Tight-lipped sort, slangily • Mind-bending stuff, as some 1960s art • Thoughtlessly reveals, as secrets • Traditional Scottish dish • Tex-Mex food in a shell • Hesitate



BOXING MATCH

By Tinh Van Duc Lai

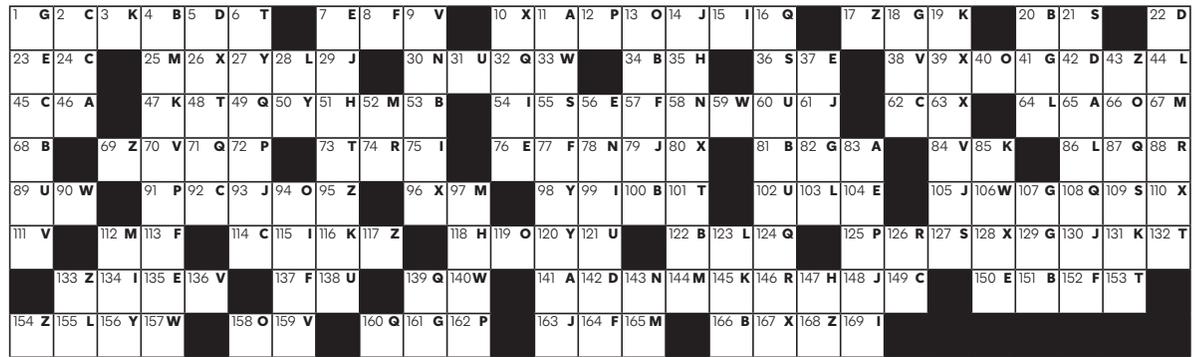
Place numbers from 1 to 9 in the grid so that each outlined region contains consecutive numbers, and so that the sum of numbers in every 3x3 area is the same. The grid has 16 overlapping 3x3 areas. Solving hint: When 3x3 areas overlap, the sum of the numbers in their unshared squares must be equal. In the example, the total of each 3x3 area is 42.



ACROSTIC

By Emily Cox & Henry Rathvon

Guess the words defined below and write them over their numbered dashes. Then transfer each letter to the correspondingly numbered square in the pattern. Black squares indicate word endings. The filled pattern will contain a quotation reading from left to right. The first letters of the guessed words will form an acrostic giving the author's name and the title of the work.



A. Fabric with a rippled pattern

83 65 11 141 46

B. Actor for whom a Shubert Alley theater is named (2 wds.)

151 68 122 20 53 166 100 4 34 81

C. Oft-repeated performance

45 92 24 114 62 149 2

D. Off-kilter, catawampus

142 42 5 22

E. Driver apt to be apprehended by a speed trap

150 104 56 135 76 23 37 7

F. All bent out of shape (3 wds.)

164 57 77 8 137 152 113

G. Exhibit of jovial warmth (2 wds.)

1 41 129 107 161 82 18

H. Burlly singer of folk songs

147 35 51 118

I. Filling for some chocolate truffles

169 15 99 134 54 115 75

J. Danger for a driver while being passed (2 wds.)

163 130 93 79 29 61 105 148 14

K. Good-natured, friendly

145 3 85 116 47 131 19

L. Style spurning tradition (2 wds.)

103 28 86 64 123 155 44

M. Supplement brand marketed to seniors

165 52 97 144 25 112 67

N. Race whose winner is given a bottle of milk, informally

78 58 143 30

O. Circle of light, halo

119 13 40 158 66 94

P. Vice president who resigned in 1973

125 12 91 162 72

Q. Drifted apart, got disconnected (2 wds.)

16 71 124 160 49 139 32 108 87

R. React to urushiol or urticaria

88 146 126 74

S. Plagiarism or piracy

127 55 109 21 36

T. Canary who "taw a pudgy tat"

73 101 6 48 153 132

U. Not covering the ankle, as sneakers (hyph.)

60 31 121 89 102 138

V. Field of vision, seeable range

9 159 136 38 70 84 111

W. "Stick of tea," to hepats

157 59 90 140 106 33

X. Unmitigated, thorough, utter (hyph.)

96 128 63 167 110 10 39 26 80

Y. River diverted to Los Angeles in 1913

120 50 156 27 98

Z. Love letter (2 wds.)

133 17 69 43 168 154 117 95

In Formation

(Continued from Page 51)

or put a store out of business. Still, each of these decisions can be modified on the micro level by human behavior. The ambulance driver's experience and his reactions to traffic conditions might mitigate his accident risk. An algorithm applies norms uniformly. Those presets would need to function nationwide, which would require countless entities with conflicting interests and values to submit to a single interpretation of what is best for most people. (Until a majority of cars are fully automated and connected, such a network would most likely behave as the Waze navigation app does, delivering information to human or automated drivers for them to interpret.)

Unfortunately, as a species, humans are notoriously inept at acting in our own long-term interest. Imagine an algorithm for hurricane evacuation that moves cars faster than human drivers would — “balancing the risk of a more-damaging accident from the higher speed against the benefit of getting people out of the evacuation zone faster,” William Whyte, a prominent automotive cybersecurity consultant, wrote to me in an email. “That would be an algorithm that on average worked better than current practice but, when it failed, would fail worse. I think that people would probably feel uncomfortable with that in the same way that they feel uncomfortable on planes — there's a combination of lack of control plus the fact that if things go wrong, they go very wrong, which triggers all the ways that people are very bad at risk assessment.”

Automation thrives in the absence of regulation; V2V depends on it. The United States Department of Transportation has long helped sponsor V2V research projects: Among the largest is a collaboration between the University of Michigan and the city of Ann Arbor that plans to have 3,150 V2V-equipped cars and 70 connected traffic lights operating there by January. Tampa, New York and the state of Wyoming have won more than \$40 million from the agency to implement V2V and other connected-vehicle projects within the next year. At least 41 states have considered legislation surrounding the deployment of automated or V2V technology; at least nine have changed their following-distance laws to permit platooning.

Without federal help, however, the upfront cost of connected infrastructure can be prohibitive for small towns and cities. Bryant Walker Smith, a law professor at the University of South Carolina and an affiliate scholar at Stanford's Center for Internet and Society, recently challenged a group of students to come up with ways to secure public funding for vehicle-to-infrastructure technology that would enable more governments to afford it. One idea was to use the technology at intersections to collect traffic data and sell it to the developers of automated systems to improve

their algorithms; another was to use the dedicated bandwidth in cars to create a meshlike internet network for rural areas, eliminating the need to put down expensive fiber cable.

Perhaps the most provocative idea, Smith told me, was a “crash bounty.” He explained: “We've posited that V2I can improve safety — what if you could come up with a scheme for monetizing that? If you could prove you had prevented a crash, you could bill the people who otherwise would have been injured or killed: ‘Good news, we're 80 percent sure that we saved you from an injury that would have cost you tens of thousands of dollars, so, insurance company, pay up \$40,000 and be happy with that.’”

To get a sense of how V2V stands to improve the system as a whole, it helps to understand how cities cope without it. To that end, on a recent Monday morning, just after rush hour, I joined Wilson Aleman and Al Vilar, who have been engineers at the Boston Transportation Department for a cumulative five decades, in the Traffic Management Center on the seventh floor of City Hall. Aleman wore a Red Sox cap. Vilar wore glasses with small eyepieces and thick lenses that gave him the look of a jeweler examining a precious stone.

In front of them, a bank of screens displayed live video of various intersections: cars double-parking on narrow, curving roads;

pedestrians disregarding stoplights. Aleman could remember when the video screens used to be a board with a real-time LED map on it — and when the department received postmarked letters of complaint instead of tweets, emails and phone calls. Over the last two decades, Boston has connected 68 percent of its lighted intersections to the Traffic Management Center, allowing engineers to adjust the signaling patterns in real time. The department estimates this has reduced travel times by about 15 percent and emissions and crashes by 8 percent each; it also yields economic benefits of approximately \$14 million each year, compared with the \$318,000 it cost to implement. Still, much of the traffic data — which helps to determine optimal signal timing as well as the city's future investments — comes from people logging car movements by hand. Widespread V2V would give traffic departments like Boston's a wealth of detailed information about key locations. (If all cars had V2V, they could blaze through complex intersections without stopping at all, modifying their speeds and headings to slide into gaps.) Maintenance, however, would be a significant challenge.

Aleman showed me his computer monitor, where the connected lights were represented on a city map as red or green dots. The red dots were ones that weather, construction or local hardware issues had taken offline. (Continued on Page 81)

BOUND FOR POSTERITY HENRY MARTIN GASSER (1909–1981)

An Artist Distinguished by 100 Awards Nationwide



Henry Martin Gasser (1909–1981) *Winter Yard, detail*

Exhibition and Sale November 10–December 9, 2017

Henry Martin Gasser's paintings are included in sixty museums, including the Metropolitan Museum of Art and the Smithsonian American Art Museum.

Request an Exhibition Catalogue Now

QUESTROYAL FINE ART, LLC

(212) 744-3586 New York, NY gallery@questroyalfineart.com www.questroyalfineart.com

'S-Q'S ME!

By Ed Sessa

ACROSS

- 1 Philbin's onetime morning co-host
- 8 Equality-promoting org.
- 12 Those who believe everything has a spirit
- 20 Off base
- 21 Small songbird
- 22 Patronized a restaurant
- 23 Prodigality?
- 25 Emmy-winning actor on "The West Wing"
- 26 Spinnny pool shot
- 27 Direct (toward)
- 29 Part of many German names
- 30 "Ready?" response
- 33 Hog seller?
- 38 Chefs' hats
- 40 Corp. budget item
- 41 1969 self-titled jazz album
- 42 Salad alternative
- 43 Trouble maker
- 46 Depend (on)
- 48 Letters of warning on internet sites
- 52 Radiologist's tool, for short
- 53 Cigar City, so-called on account of a former major industry
- 54 A part of Life?

ACROSS

- 55 Irritate
- 56 Suffix with market
- 57 Mr. Magoo biopic?
- 62 Actress Thurman
- 63 N.Y.C. subway letters
- 65 High school sweethearts
- 66 "___ said ..."
- 68 Birthplace of Emily Dickinson
- 71 Sloppy sort
- 72 Roadblock
- 73 Canadian coin, informally
- 74 Like rebate coupons, typically
- 78 "How cool!"
- 79 Actor Kilmer
- 80 Cuckoo or dodo?
- 83 Locale for a flock
- 86 Nonreactive
- 88 Abbr. in a military title
- 89 Dark times, informally
- 90 Trickster
- 91 Mariner's org.
- 92 Small
- 93 Resembling down
- 95 General ___ chicken
- 96 Buccaneer's quaff
- 98 Was on a crowded bus, say
- 100 Soprano Renata

ACROSS

- 102 Prepares cube steak?
- 107 Altar sites
- 108 A/C stat
- 109 Gay who wrote "Frank Sinatra Has a Cold"
- 110 "I ___ talking to you!"
- 112 The "E" of E.D.
- 114 All-day gripe sessions?
- 121 Like a rope in tug of war
- 122 Northern Iraqi
- 123 Alter ego on "The Simpsons"
- 124 Tightwads' opposites
- 125 Hungers
- 126 Questionable

DOWN

- 1 Ones in a mess, informally
- 2 Question: Abbr.
- 3 Pot-au-___ (French stew)
- 4 Basis of the plot of "Gone Girl"
- 5 Like Corinthian columns
- 6 Bacilli shapes
- 7 Habiliments
- 8 Cobbler's tool
- 9 Vineyard designation
- 10 ___ Cayes (Haitian port)
- 11 Not related?
- 12 Gilbert who wrote "Love and Death on Long Island"

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
20							21				22								
23							24				25								
			26						27	28							29		
30	31	32					33		34	35	36						37		
38						39			40				41						
42						43	44	45			46	47				48	49	50	51
52						53					54				55				
56						57				58	59	60			61			62	
			63	64			65						66		67				
68	69					70			71				72						
73							74	75				76	77			78			
79						80		81						82			83	84	85
86			87				88					89						90	
91							92				93	94					95		
							96	97							100	101			
		102	103						104				105	106			107		
108													110		111				
112																			
121																			
124																			

- 13 Rosetta Stone discovery site
- 14 In a senseless way
- 15 Deranged, in slang
- 16 Polish movie named Best
- 17 Work out
- 18 Henry VII's house
- 19 Lee who co-created the Avengers
- 24 Not an elective: Abbr.
- 28 Flower colored by Aphrodite's blood, in myth
- 30 "You know who this is"
- 31 "A Visit From St. Nicholas" poet
- 32 Ways out of embarrassing situations?
- 34 Polished
- 35 It may have a ring to it
- 36 Enero a diciembre
- 37 Civil rights activist Guinier
- 39 Laker legend with a size 22 sneaker, informally
- 44 Something absolutely necessary
- 45 Fast-paced two-player card game
- 47 Munchies, say
- 49 Enumerations of things to be sat on?
- 50 Is plenty angry
- 51 Song words before "the World" and "the Champions"
- 53 Like pre-1917 Russia
- 55 Green shells
- 58 Animal with a flexible snout
- 59 Early title for Julius Caesar
- 60 Brightest star in Orion
- 61 Apollo 11's Eagle, for short
- 64 What Lionel Messi wears
- 67 Brazil's ___ Bernardo do Campo
- 68 Choreographer Ailey
- 69 2016 film set in Polynesia
- 70 Et ___ (footnote abbr.)
- 72 Document certifiers, for short
- 74 Countenance
- 75 Sorting category on iTunes
- 76 Vacuum-tube component
- 77 Cousin of a spoonbill
- 81 Alleged psychic exposed by the Amazing Randi
- 82 Co-authors Margret and H.A.
- 84 Theatricalize
- 85 Lhasa ___ (dogs)
- 87 "Old World Style" pasta sauce brand
- 92 Glacial deposit
- 93 Opposition
- 94 Easy question
- 95 "I dare you to do better!"
- 97 Snitched on, with "out"
- 99 Lucy's place, in a Beatles song
- 101 "Impossible!"
- 102 Leash, e.g.
- 103 Line (up)
- 104 Ones on the outsides of brackets
- 105 "Yuck!"
- 106 Forgeries
- 108 Pot growers?
- 111 Kind of vaccine
- 113 Cardboard container: Abbr.
- 115 "___ pasa?"
- 116 Decorative garden item
- 117 Source of much of Google's income
- 118 Fictional creature made from heat and slime
- 119 Unspecified degree
- 120 ___ milk

Puzzles Online: Today's puzzle and more than 9,000 past puzzles, nytimes.com/crosswords (\$39.95 a year). For the daily puzzle commentary: nytimes.com/wordplay.

KENKEN

Fill the grid with digits so as not to repeat a digit in any row or column, and so that the digits within each heavily outlined box will produce the target number shown, by using addition, subtraction, multiplication or division, as indicated in the box. A 5x5 grid will use the digits 1-5. A 7x7 grid will use 1-7.

8×	2÷		2-	
	6+	1-	2÷	
			5	1-
8+		3+		
3	20×		1-	

2÷		5	5-		5+
6+	5-		15×		12+
	6	5-		15+	16+
	3-	12×			
16+			13+		5+
		6×			12+
3-			1	1-	

KenKen is a registered trademark of Nextoy, LLC. © 2017 www.KENKEN.com. All rights reserved.

In Formation

(Continued from Page 79)

He pointed to two reds very close together on Commonwealth Avenue that could strand cars between them and block cross-traffic. “Those are the ones I like to attack,” he said. “Those are important to me.” The phone rang. It was a communications specialist who was elbow-deep in a control box on one of Aleman’s corners, working on a surge protector. “Maybe if you unplug one at a time?” Aleman suggested.

On another phone, Vilar was patiently discussing the timing of a new light on Endicott Street at Keany Square with one of the street’s residents. “We’ll get it so it’s working better; right now it’s working safer because there’s less cars coming at you.” He paused. “They’re ready to march on City Hall, I know.” One-way, residential Endicott begins as an offshoot of I-93 North and ends where the causeway and the Charlestown Bridge converge as six lanes. The light makes it slower to turn left. But, Vilar explained once he’d hung up, “we can’t make it beautiful, because then it will siphon off cars from the causeway.”

He pointed to the Endicott video feed where, sure enough, a line of cars was forming. “See, now it’s like 14 cars deep, people honking — you want it to be more serene, especially when you’re eating dinner,” he said. But say those cars weren’t there, and I-93 was backed up, and Google Maps began suggesting Endicott as a shortcut. “So now you’ve got a guy who just got off there, maybe he’s enraged, instead of going 30 he’s going 40, a kid runs out into the street because he’s not used to the traffic being there. . . .” Vilar said. “You want to make it so it’s moving. You want him to think: I’ll be O.K. I don’t want to get off this street. I’ll stay.” A V2V network could make these sorts of intricate adjustments instantly and indefatigably, but it would do so without Vilar’s empathy for the harried commuter or the family conversing over supper.

“Sometimes people call,” he said, “and they just want to rant, and you’re just a punching bag for those people, and that’s part of the job.” Vilar grew up in the North End; he, his wife and his children still live nearby. “The woman who just called, she’s almost like an aunt to me,” he said. “She has my number.”

Traffic may be impersonal, but we experience it intimately. Its smells, sounds and movements are as fundamental to our daily passages as the weather. The transition from horses to cars transformed the nature of cities, Ann Norton Greene writes in her 2008 history, “Horses at Work”: “In the name of safety and efficiency, urban Progressives moved children into supervised urban playgrounds, installed new traffic regulation devices, placed policemen on the streets and encouraged changes that turned streets from spaces in a neighborhood to spaces through a neighborhood.” Vehicles, in

this milieu, served as a “protected, private space, an extension of the private home.”

More than a century later, in the context of platooning, privacy seems to be able to foster community as much as disrupt it. The dedicated channel over which one truck controls others allows the drivers to converse exclusively with one another, as opposed to using their C.B. radio, which is rife with vulgar chatter. Dave Mercer used to keep his turned off unless he needed news about road conditions. But during the test run, he and Jake Gregory exchanged frequent notes on moves they planned to make or vehicles that the other couldn’t see; Mercer described it as “Jake and I looking out for each other on the road.”

Might the opportunity to collaborate with colleagues in this way reform the macho trucking culture, increasing the diversity of drivers, only 5.1 percent of whom are women? Or might including more varied perspectives in the design process result in even more innovative applications of V2V? The homogeneity at leading technology companies is well documented. Still, it seems notable, considering how infrastructure and power reinforce each other, that of the several dozen engineers, academics and standards developers I spoke with whose thinking is shaping the future of V2V, most were white and all but one was male.

Artificial systems evolve — just as natural systems do — by applying strict rules to events that

are often swayed by chance, and the results are frequently surprising. Relinquishing control of our vehicles to algorithms may ultimately transform us from drivers to passengers who tranquilly observe our surroundings from within our bubble or ignore them altogether in favor of watching a movie or checking email. Then again, by the time that sort of algorithm is ready, more and more of us may choose to depend on ride-sharing applications like Uber and Lyft for personal travel and delivery services, or even 3-D printing for goods we once needed a car to go get and pay for. “I have three daughters; they’re totally uninterested in driving,” Jack Pokrzywa, director of global ground vehicle standards for SAE International, told me. “When I got my license, I was 17. I was in seventh heaven.”

For those of us for whom a visit to the D.M.V. was a rite of passage, it’s easy to forget that, before Americans found freedom inside a motor vehicle, they found it on foot and astride horses, in covered wagons and trains, on ships, buses, planes, bicycles, roller skates. They found it in pure motion, on a journey to someplace beyond what they could imagine. Where it began and where it ended was still theirs to decide. Likewise, automated connected vehicles stand to make travel safer, maybe even boring, but somebody still has to get in and tell them where to go. ♦

Give good design.

store.moma.org

PHOTO BY ILAN RUBIN

Midtown NYC. Soho NYC. Tokyo. Kyoto.

MoMA Design Store

ENDPAPER

The Museum of Driving

BY TOMI UM



DRIVE-IN

MONSTER TRUCKS

PUMP YOUR OWN GAS

TRY PARALLEL PARKING

VINTAGE-CAR PARADE

EXPERIENCE THE TRAFFIC JAM

WHO CAN FIND THEIR CARS?

DRAG RACE

PP

PP

00082

THE UN-SNEAKER™



Ah, the comfort of a sneaker and the style of ... not-a-sneaker.
That's pure Hubbard. Because your feet deserve to look good and feel good.

SAMUELHUBBARD.COM

S H O E M A K E R S S I N C E 1 9 3 0

Free shipping and returns. Order online or call 844.482.4800.



I CAN SPOT TROUBLE FROM 18,600 MILES DOWN THE TRACK.

With IBM Cloud and Watson IoT, railway COOs can spot potential issues before they have a chance to cause a problem. By tracking data from thousands of sensors in real time, they can deliver a smoother customer experience—every mile along the way. Find out more at ibm.com/you

This is transportation to the power of IBM.

you^{IBM}

