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Sacred cows in the road

News that Apple, Inc. has secured permission to test its autonomous vehicles on California's public roads heightens anticipation of the close of the age of the steering wheel. In the brave new world that Google's Sergey Brin imagines, "a fleet of vehicles could operate as a personalized public-transportation system, picking people up and dropping them off. . . . Streets would be clear, highways shrink, parking lots turned into parkland."

We write to say that it won't happen, at least, not over any practical investment horizon, nor on the scale that such visionaries as Brin and Elon Musk anticipate. The trouble with autonomous vehicles is the people who won't be riding in them.

The skeptical case on the autonomous revolution derives from familiar arguments against human engineering in other forms—activist central banking, for one. It's the human response to the plan that usually trips up the planners.

So the autonomous vehicle is very much a topic for the monetary-minded *Grant's* reader. It will likewise pique the interest of insurance investors, Uber investors, worriers about technological unemployment and other parties to the supposedly imminent revolution in American personal mobility. If we're right, there will be no revolution. Evolution is a better bet—a slow-moving, decades-long integration of autonomous-driving technology into the existing ecology of budget-minded motorists, daredevil bicyclists, plodding politicians, texting pedestrians, controlling coders and suing lawyers.

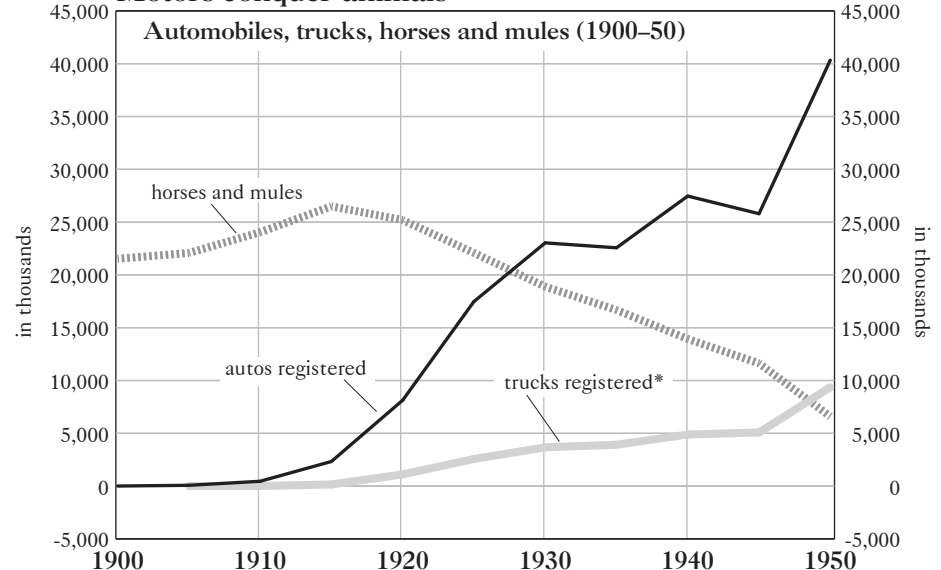
It was reader Paul J. Isaac who set this investigation in motion. How, he

wondered, did society cope with the intermingling of animals and automobiles more than a century ago? What was the tempo of innovation? Will it be any easier to mix autonomous vehicles with people?

Colleague Harrison Waddill, having immersed himself in the automotive archives and in the contemporary work of the risk theorist John Adams, reports that the transition to car and truck from horse and mule was essentially completed in 25 years. The Ford Motor Co. was incorporated in 1903. It was during the Coolidge presidency—at about the time of Lindbergh's solo flight across the Atlantic—that American automobiles finally outnumbered American horses and mules.

City dwellers couldn't wait for the animals to leave. As late as 1910, more than 128,000 horses toiled in the streets of Manhattan. They bit, kicked, reared up, stumbled, fell—not that they weren't provoked. They shied at the sight of a flying piece of paper and, when disease or old age overtook them, died on the job, in harness, their carcasses blocking traffic. Or they keeled over in the stables, as so many did in the influenza epizootic of 1872, or from azoturia (brought on by enforced idleness) in the wake of the blizzard of 1888 or in ghastly fires. Then, too, horses transformed feed into manure, some 20 pounds a day per animal, and water into urine. These emissions fouled the air and bred flies and spread

Motors conquer animals



*Series starts in 1904.

sources: U.S. Bureau of the Census, The Humane Society of the United States

disease. In 1908, Harold Bolce, writing in *Appleton's Magazine*, demanded legislation to ban the horse from city streets—it was a plague on four legs. “One of the fantastic anomalies of the day,” Bolce remarked, “is the spectacle of a tank wagon filled with kerosene or gasoline hauled about by horses.”

The Brins and Musks of the early 20th century impatiently tapped their feet. “It is only a question of a short time,” Thomas A. Edison was quoted as saying in 1895, “when the carriages and trucks of every large city will be run by motors.” Maybe the Wizard of Menlo Park was thinking of the lightning-fast adoption of electricity to power street railways; it took little more than five years to phase out horse-drawn cars after the first successful demonstration of electrical trolleys by Henry Whitney and Charles Francis Adams Jr. in a line connecting Boston and Brookline, in 1888.

Slow and bumpy was rather the pace of automotive adoption. As late as 1913, Henry Ford complained that the miserable condition of the roads prevented him from delivering his Model T within a 100-mile radius of the Ford Detroit factory. At that, the automakers made faster headway than did the industrial adopters of steam power. In 1875, a century after James Watt's invention of the biceps of the Industrial Revolution, *Scientific American* was able to observe that “no [steam] engine adapted to the needs of the workshop was available.” (We here borrow from the excellent essay “The Decline of the Urban Horse in American Cities,” from the September 2003 issue of *The Journal of Transport History*.)

Gasoline- and electricity-powered vehicles displaced animals not at once but as need and technology intersected. Horses—bred for massive size and strength—held their own in the business of hauling grand-piano-size freight until the coming of the government-sponsored heavy-duty chassis in 1917. As a residential milk-delivery animal, the stable nag proved a kind of natural autonomous vehicle. Knowing when to go and when to stop, it kept its job into the mid-20th century.

As for cars, unskilled drivers thronged undeveloped roads. In New York State in the depression year of 1921, automobile registrations jumped by 100,000, to 783,000, with no corresponding increase in roadway. “[T]here is injected into this dangerous congestion,” warned an officer of the Royal Indemnity Co. in the pages of *The Weekly Underwriter*, “a large number

of inexperienced drivers who are undertaking for their first time the operation of an automobile.”

So it was that, in 1920, there were 9,103 national automobile-related fatalities with 8.1 million cars on the road. In 2015, auto-related fatalities amounted to 35,092 with 112.9 million cars on the road.

Certainly, today's cars and trucks are safer, faster, more comfortable and less toxic than the horse-drawn conveyances that Carl Benz, Charles Duryea, Ransom Olds and Henry Ford disrupted. One hundred years ago, city-dwelling Americans fairly begged for deliverance from the animals. No such customer-driven push is apparent for access to autonomy. You don't find it in surveys—in January, the American Automobile Association found that 75% of the motorists it polled said they'd be afraid to ride in a self-driving vehicle. Nor do you find it in the marketplace. The impetus is rather coming from on high, from the car makers, from the software giants and from Uber.

Resistance may come from the consumer. Autonomous-style technology isn't cheap, as Tom Wilson, chairman and CEO of Allstate Corp., reminded a Sanford C. Bernstein audience a couple of years ago. “If,” said Wilson, “you have a car today that has a little thing on the rearview mirror, on the side mirror, that tells you when someone's there—if you knock that off by driving into a garage, it probably costs over 1,000 bucks to replace it.” Actually, as a mechanic at a New York area Mercedes Benz dealership informs Waddill (“Are you ready for this?”), the parts and labor to replace a driver-side mirror on a 2014 Mercedes E-Class station wagon will set you back \$2,480.80.

The average car in use is 10 years old, while the life expectancy of work horses a century ago was just four. And even if the median American income were higher than \$56,500, and even if the average cost of a new car, pickup truck or SUV were less than \$34,300, no automotive historian would bet on the fast adoption of a radical new technology.

Automatic transmissions, developed in the 1930s, became “reliable and affordable” only in the '80s. Airbags became standard on some models in 1988, 15 years after their debut in 1973 (they achieved a 100% market share only under the lash of a 1998 federal mandate). According to the Victoria Transport Policy Institute, the “deployment cycle” for hybrid vehicles was 25-plus years; for navigation systems, 30-plus years.

Autonomous-type enhancements, too, have met with a wary welcome in the marketplace. Electronic stability control, which helps a driver to stay steady on hard curves, has been available for 20 years. In those two decades, it has achieved 50% market penetration. Forward-collision warning has been in the market for 10 years, during which time it has achieved 5% market penetration. Honda dealers find that lane-departure technology (which tells you when your car is drifting) is deactivated on 70% of the vehicles that customers drive in for service (this, according to a 2016 presentation by Adrian Lund, president of the Insurance Institute for Highway Safety and of the Highway Loss Data Institute).

And it may say something about the demand for modernity that E-ZPass, the drive-through toll technology that debuted in 1993, claimed 31 million customers out of a possible vehicle base of 87.6 million in 16 eastern and Midwestern states in 2015. For New Yorkers, E-ZPass costs \$25 to get started and \$1 a month thereafter. If you speed through a toll plaza or miss a payment or one of your checks bounces, you incur other charges. The gross opt-in rate of 35% seems low. Certainly, not everyone is willing to trade time for money in the same proportion. Some people make detours to avoid toll roads and bridges. Others prefer the anonymity of cash to the intimacy of data-sharing (sharing, that is, with whomever finally comes to know where you went and how you got there). Whatever the reasons might be, they do not exactly describe a consumer base that will blindly follow the techno-pioneers of Silicon Valley.

Nor may the taxpayers be so keen for autonomy after the government has presented them with the bill to upgrade the nation's highways. Driverless cars don't work on dirt roads. They require relatively pothole-free, clearly marked hard surfaces. “Volvo's North American CEO, Lex Kerssemakers, lost his cool as the automaker's semi-autonomous prototype sporadically refused to drive itself at a press event at the Los Angeles Auto Show,” Reuters reported last year. “‘It can't find the lane markings!’ Kerssemakers griped to Mayor Eric Garcetti, who was at the wheel. ‘You need to paint the bloody roads here!’”

Still, the self-driving evangelists insist, autonomous vehicles are just around the corner. The consensus holds that “level-four” autonomy—only one step below the fifth level of complete, Jetsons-like

surrender of hands-on control—will arrive by 2020 or 2021. Come that jubilee, *The Times*, London, recently quoted a San Francisco analyst as predicting, there will be no more accidents, no more congestion, no more snacking or cigarette-smoking (sinners poison themselves at gas stations). Streets will be greener, cyclists more numerous, cab fares ridiculously cheaper (no need to pay the driver).

Last summer Ford cleared its throat and declared its intention to produce “vehicles capable of driving fully autonomously within five years. No steering wheel. No gas pedals. No brake pedals. A driver will not be required.” And it added: “It’s now clear that the next decade will be defined by automation of the automobile. In fact, we see autonomous vehicles as having as big an impact on society as Ford’s moving assembly line did a hundred years ago.”

It’s not all words. Sam Abuelsamid, senior research analyst at Navigant Research, points out that Ford recently committed to invest \$1 billion over the next five years in Argo AI, an artificial intelligence and robotics startup founded by alumni of Google and Uber. Abuelsamid says he reckons that \$5 billion to \$10 billion will be invested in autonomous driving in the next five to 10 years, approximately matching the total already spent.

The question before the house is whether any number of billions will render humans programmable. We turn here to John Adams, emeritus professor at University College London and author of the wonderful 1995 volume *Risk*. A thinker about the paradoxes of risk and safety, Adams has challenged the autonomous-vehicle juggernaut to solve the problem of a ball rolling into the street in front of a driverless car.

In a sense, the engineers *have* solved the problem, Adams acknowledges in a

2015 essay posted on his website. Because a child might be chasing the ball, the programmers command the car to slam on its brakes. But in creating this response, the visionaries “will have invented an exciting new game for children: Throw the ball and watch the car stop.”

It’s one thing for autonomous cars to move in the company of other autonomous vehicles. The trouble starts with the automatons’ interaction with pedestrians and cyclists.

“Moral reckoning to one side,” Adams observes, “anticipation of the public-relations disaster that would follow the killing of the first child by a driverless car demands failsafe programmed deference to those on the street but not in cars. This deference would clearly become obvious to pedestrians and cyclists and, secure in the knowledge that they were now kings and queens of the road, their behavior would surely change. Pedestrians would no longer cower at the roadside trying to judge whether gaps in the traffic could see them safely to the other side. They would be liberated to stride confidently into the road, knowing that traffic would stop for them. And all cyclists, not just children, could enjoy the freedom to cycle two or three abreast with friends, holding up middle fingers to the cars honking behind.”

To which you may say, better these problems than the present state of play, which heavily features texting drivers oblivious to the presence of texting pedestrians. Yes, Abuelsamid tells Waddill, autonomous vehicles may make the wrong decision, “but the likelihood is that, in aggregate, the vehicle is probably going to make fewer wrong decisions than human drivers.”

Adams, reached for comment, is unyielding. What’s wrong with the theory of autonomous mobility is what’s wrong

(and, in a way, what’s right) with the human condition. Anyway, no engineering work-around is available to fix it.

“To provide the safe liberation of those unable to drive extolled by the proponents of autonomous vehicles—to enable Uber without drivers—these vehicles will have to be able to offer a door-to-door service in urban areas,” Adams writes. “In such areas autonomous vehicles will encounter many sacred cows, other road users to which they have been programmed to defer. The rapidly expanding literature on autonomous vehicles acknowledges that the legal framework covering roads, vehicles and their users will require substantial revision to accommodate the introduction of vehicles without drivers. But the problem of deferential paralysis has yet to be addressed.”

Adams playfully suggests that research begin in a part of the world already “living with the problem” of sacred cows on public thoroughfares—New Delhi, for instance.

If Adams is right, Uber’s imputed private-equity value of \$69 billion (on an “adjusted net loss” of \$2.8 billion in 2016, including \$991 million in the fourth quarter alone) is wrong. Especially is that valuation wrong if, supporting it, there is the hope of a timely switch to autonomous Ubers. “Deferential paralysis” figures in no private-equity business model.

We endorse the Adams approach to autonomous driving because it jibes with what we observe in other departments of human affairs, notably the monetary one. If the central bankers have proved nothing else in these eight post-crisis years, they’ve proven how hard it is to push people into doing what people would just rather not do.

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