In the Year of Our Ford: The Automobile Era (February 29th, 2012)

A. The Automobile before the Automobile

Inventing the automobile was comparatively easy. More than one solution was found in the course of the 19th century to the problem of powering a vehicle over roads. As was mentioned, the first steam vehicle was built in the 18th century. Many more steam-powered coaches, trucks, and carriages were built during the 19th century. Electric cars were also developed by the end of the century, as well as cars driven by internal combustion motors. For a time, all of them competed for dominance.

Before World War I, the Stanley Steamer produced in Massachusetts was a steam car still competitive with cars powered by internal combustion engines or electric batteries. According to one argument, its fate illustrates the role of contingency in the evolution of technology. Its steam engine's need for water meant it had to use the horse and cattle troughs found along streets and roads. When a hoof and mouth disease outbreak led to the banning of such troughs (thought to spread the disease), the Stanley Steamer company was forced to redesign its engine so as to recycle the initial water supply.

By the time a closed cycle had been designed, gas-powered cars had taken an unreachable lead and many of the steam car manufacturers remained small concerns that were crushed by the methods of mass production. The typical steam car was more complicated to get started though easier to operate once in motion (no transmission shifts). After World War I, conventional gas-powered cars in the same price range were not only easier to start, but routinely achieved higher speeds (80 km/h vs. 60 km/h) as well.

During the 1920s, the companies making steam cars either converted to internal combustion (White) or went under (Doble, Stanley). Some late entrants (such as Brooks Steam Motors Ltd, established in Stratford, Ontario, 1924-1929) appear to have been highly speculative ventures, if not outright frauds.

Electric cars were never in the running, in spite of the best efforts of the Edison companies which pushed electric vehicles for many years. Even though the performance standards expected of cars were still low, electric batteries of the time could move a car, but not any significant payload or over a long distance before exhausting its charge. By the end of the 19th century, internal combustion engines had gone through nearly forty years of development since the first gas-burning prototype built by Belgian Étienne Lenoir and the theory of the four-stroke engine outlined by French inventor Beau de Rochas in 1862. (Engines using the explosions of a gaseous mixture to actuate a piston, obviously inspired by 17th-century experiments, were built even earlier by such inventors as the Niepce brothers in France around 1806 and Alfred Drake in the U.S. around 1855.)

The first workable internal combustion engine was put together by German engineer Nicholas Otto in 1876; its power and light weight made it ideal for vehicles. Less than ten years later, it was propelling cars. The Diesel engine was invented a few years later, achieving high thermodynamic efficiency.

In the United States, the first horseless carriage is usually attributed to the brothers Charles E. and J. Frank Duryea, bicycle mechanics who copied in 1893 a design by German car builder Karl Benz. (This highlights the importance of bicycles. Another pair of brothers involved with bicycles were the Wrights, who built the first real airplane by combining glider technology with the internal combustion engine in 1903. And bicycle manufacturing led to the installation of the interchangeable parts system in many shops, supplied the machine tool industry with a crucial outlet in the 1890s, and experimented with new techniques such as sheet metal stamping and electric resistance welding.)

Even when the internal combustion engine prevailed over the alternatives (steam, electric), the choice of fuel was still somewhat open. Besides gasoline, ethanol was considered to be a viable possibility by people like Henry Ford. Chemists also investigated the conversion of waste straw and other vegetable matter into biogas. In Canada, a company such as Ottawa’s Iogen Energy Corp. is still striving today to perfect the conversion of cellulose (from straw) into ethanol using enzymes at a competitive price. Other companies are resorting to other technologies and feedstocks in the hope of having renewable fuels supply 27% of the world’s transportation needs by 2050, instead of the current 2%.

[Shawn McCarthy,, "Fuel from straw: the hunt for an elusive recipe", *The Globe and Mail* (5 July 2011): B1, B4.]

Henry Ford began tinkering with automobiles in 1896 and made his reputation as a builder and driver of fast cars. He formed the Ford Motor Company in 1903 and launched the Model T in 1908. It cost less than comparable cars ($825-850), but it could generate twenty horsepower, which was unprecedented for cars in that price range. Ford advertisements did not lie when they claimed: "No car under $2000 offers more, and no car over $2000 offers more except the trimmings."

B. Mass Production

Building automobiles for the masses was a harder problem than merely designing or inventing them and it stimulated the development of the modern assembly line. Some of the principles of mass production were already known in the 18th century when Adam Smith described how a pin factory, by breaking down the job of making pins into several specialized tasks, was able to turn out many more pins than an equivalent number of workers could have done if each had been charged with making pins from start to finish. The Cincinnati and Chicago meatpacking plants evolved "disassembly" lines to process animal carcasses. Late in the 19th century, Taylor introduced the stopwatch in factories to determine the optimal pace at which a given job should be done.

Taylor himself was mostly concerned with efficiency, which entailed reducing costs and resulted in better profits. Ford placed more emphasis on production. Both courses of action improved productivity. Productivity is usually defined as the ratio of total production to total costs, however defined. (The classic economic definition restricts it to the value generated by an hour of work, but there are other definitions.) This means it can be increased by increasing production or reducing costs or both.

Taylor's drive for efficiency increased productivity, but not necessarily production (doing the same with less, one could say). Ford, on the other hand, focused on efficiency as a way to increase production (doing more with less or with the same): instead of improving efficiency as a way to cut costs and increase profits, he improved efficiency as a way to increase production and cut prices so as to dominate the market. This was not a decision that could be made by Taylor and his colleagues; as efficiency experts, they were essentially hired as consultants, not to make strategic choices.

But Ford was an entrepreneur with a vision. The United States enjoyed a larger internal market than almost any other developed country by the first decade of the 20th century. As a result, mass production was particularly well-suited to the North American context. Ford realized this. His workers were more efficient than other workers in the fledgling automobile industry, but he was also ready to hire enough of them to boost production and achieve volumes that would let him lower prices. And Ford didn't stop with just making each individual job more efficient; he oversaw a wholesale rethinking of car production.

Ford and his engineers added little that was new to mass production, but they pulled together every strategy known to industrial managers. The subdivision of tasks was carried very far and each job was timed carefully. Parts were interchangeable and manufactured precisely to fit the first time. Parts were always within reaching distance or nearly so. Machines were developed to replace actions formerly performed by humans. Travel was minimized: the moving assembly line brought the work to the worker instead of it being the other way around. This was the distinctly American contribution to the development of the automobile: not the manufacture of a truly innovative vehicle, but the mass production of utilitarian models made with interchangeable parts, and so cheaply that they could be targeted at the mass market. The end result was a product that was designed to vary as little as possible.

Ford established Fordism at the new manufacturing plant built in Highland Park near Detroit, Michigan. By the summer of 1913, magnetos, transmissions, and motors were being constructed on assembly lines. Within a few months, their production threatened to swamp final assembly of the chassis, and so the chassis too was turned over to assembly line production. Between October and December 1913, the time required to assemble the chassis fell from 12 hours and 30 minutes to 2 hours and 40 minutes. Part of the (substantial) cost savings were converted into Ford's celebrated pay rates, but another part was passed on to customers in the form of lower prices. Even during a period of inflation, the price of the Model T dropped from about $850 in 1908 to $360 by 1916. (It dropped down to $290 by 1927, in spite of renewed inflationary pressures.)

The eight-hour shift defined by Ford as a work day became the new standard. Long sought by the labour movement, the eight-hour day was now shown to be perfectly compatible with profitability. On February 20, 1930, this was confirmed in Canada by the passage of the *Fair Wages and Eight-Hour Day Act* after nearly 20 years of debate, giving workers under federal jurisdiction the eight-hour workday.

Though Ford wanted to bring automobiles to the masses, workers did not always like his new model for industrial work. Ford thought and stated that some men and women were willing, or even loved, the repetitive, mind-numbing labour of assembly line production. Was that because there really were different types of people or was it because there were different types of desperation? Ford's workforce included many black Americans, in part because they could rarely find equivalent work elsewhere. It might well be argued that, ultimately, Taylor's and Ford's job simplification prepared industry for the use of robots.

In any event, Fordism ended up losing by winning. Ford captured such a huge share of the market that most of his competitors (outside of luxury car builders and special-purpose constructors) were forced to move over to some version of his system. However, Ford had created such a rigid system ("Any customer can have a car painted any colour that he wants so long as it is black.") that he opened avenues for his competitors to exploit. Chief among them was Alfred P. Sloan of General Motors, who was sufficiently attuned to consumer sensibilities to realize the importance of offering a way for buyers to feel different—product choice being indispensable to self-definition. General Motors therefore produced different yearly models in a variety of colours for different markets. In 1923, Sloan became the leader of the combination of companies assembled under the aegis of General Motors (Cadillac, Buick, Chevrolet, Delco, Frigidaire, and several more) and he reorganized the whole company by splitting the production divisions for parts and finished automobiles, and by creating separate agencies for research, advertising, and product planning. By 1927, GM outsold Ford. (In fact, a single division of General Motors—Chevrolet—sold more cars that year than the whole of Ford.)

C. The Car and its Roads

C.1 The Technological Evolution of the Car

As an artefact, the American automobile evolved rapidly after World War I. The Model T was still something of a horseless carriage beholden to its design at a time when there were more bicycles and horse-drawn carriages than motor cars on the road. By the time the United States entered World War II, the cars found on American roads had been shaped by a new concern for comfort and streamlining. Their engines were larger than those of contemporary European cars, often constrained by taxes based on horsepower. The shift from four to six cylinders began in the 1920s, from six to eight in the 1930s. The bodies of American cars were also more likely to be all-steel, and to be roomier, since the price of steel was lower than elsewhere. Hypoid gearing (introduced by the Packard Motor Company in the late 1920s) made it possible to build low-slung cars. All cars had four-wheel brakes by 1930, and a few had hydraulic brakes for more prosperous buyers. Automatic transmissions were marketed in the late 1930s, after more than fifteen years of development based on patents for the epicyclic gearbox, the torque converter, and hydraulic coupling.

C.2 The Ecological Impact of Paved Roads

On a larger scale, providing cars and trucks with fuel (which demanded the creation of a network of gas stations), and then with roads (eventually snow-free in Canada), and then with highways modified the North American landscape.

It was in Paris, in 1838, that asphalt was originally used to pave streets (on a concrete foundation) as an alternative to such alternatives as medieval cobblestones, granite blocks, hard bricks or macadam. This asphalt was a naturally occurring material (rock asphalt) found *in situ* at Val de Travers, in Switzerland. Over the next thirty years, major cities in the United Kingdom, France, and Belgium adopted or experimented with asphalt paving, and they imported increasing quantities of mined asphalt from Trinidad, in the Caribbean. New York experimented with asphalt paving in 1869 and other North American cities followed suit progressively.

By 1880, the invention of the bicycle created a new class of road users who began to agitate for better roads between cities. While the lobbying efforts of cyclists and their associations did not result in significant road improvements, they did lead to the creation of university courses on road construction for engineers and to the launch of the federal Office of Road Inquiry (ORI) in the United States in 1893. Within a few years, automobilists added their voices to the cyclists and farmers who were calling for better roads. The ORI became the Office of Public Roads in 1905 and it played a greater role in advising local authorities as to the best road design and construction practices. By 1910, most of the asphalt used for paving in the United States was not imported from natural sources, but was a mix including petroleum fractions from refineries producing gasoline for cars.

[I. B. Holley, Jr., "Blacktop: How Asphalt Paving Came to the Urban United States", *Technology and Culture,* **44** (October 2003): 703-733.]

At the turn of the century, the United States had something like 3,000,000 km of rural roads, but only 220 km were paved. Even in 1915, the new transcontinental Lincoln Highway was mostly a gravel road, with a few miles of concrete and macadam (even brick). Planning to cross the country, 14 travellers left in cars from New York on May 15, 1915, and arrived in San Francisco 104 days later. In 1919, **Thomas Harris MacDonald** became the head of the United States Bureau of Public Roads and he would oversee decades of effort to remedy the poor state of U.S. roads until his firing in 1953.

During the Depression years, public investment in infrastructure (especially roads and streets) increased markedly. Between 1928 and 1950, the stock of public streets and roads in the U.S. almost doubled. Most of the growth (over 4% annually on average) happened before the U.S. entered the war in 1941. Before the Second World War, however, few of these roads were true divided highways.

By the time of the Second World War, divided highways were celebrated in the United States as vital to the economy and to defence. The country's inhabitants drove an increasing number of motor vehicles (97 million in 1967) and covered an increasing number of miles (960 billion in 1967). Carefully laid-out highways would reduce the mileage between major cities (by up to 25% in some cases) and would reduce the driving time even more (thanks to the absence of all traffic flow interruptions). They would also be safer than the old primary roads (the median strips made head-on collisions least likely) and they were also easier on the cars (reducing fuel and maintenance costs). Indeed, by 1967, studies suggested that the accident fatality rate on the completed portions of the interstate highways was 2.8 deaths per 100 million vehicle-miles as opposed to 6.9 for the older roads.

Originally, the U.S. interstate highway system alone was planned to span 65,000 km when it was to be completed in 1975. It is no coincidence that president Dwight Eisenhower's chief transportation adviser was Lucius D. Clay, chairman of General Motors. The rise in the number of cars as the system was being built was probably the mere extension of a long-established trend, but it is highly likely that the availability of new divided highways made cars more useful and promised to make driving simpler.

Officially known as the "National System of Interstate and Defense Highways", it required at least 6500 square kilometres of land for right of way, an area larger than the state of Delaware. The law passed in 1956 under president Eisenhower mandated a partnership between the federal and state governments. Through the Bureau of Public Roads, the federal government paid 90% of the costs and retained a right of approval and oversight. The individual states determined the routes and designed the highways. The original target date for completion was 1972, though it was later pushed back to 1975 as costs rose, new standards (for safety, especially) were implemented, and urban opposition organized. In Boston, for instance, the Inner Belt (which would have become Interstate 695) was cancelled in 1971 due to strong opposition by community activists. Under pressure, the U.S. Congress passed laws that allowed public transit projects to be financed in part out of funds allotted for interstate highway construction.

[Raymond A. Mohl, “Race and Space in the Modern City: Interstate-95 and the Black Community in Miami”, in *Urban policy in Twentieth-Century America*, Arnold R. Hirsch and Raymond A. Mohl, eds. (New Brunswick: Rutgers University Press, 1993), pp. 100-158.]

Other countries have made choices between faster commutes and the existing urban environment. For instance, in 1993, an East London neighbourhood faced demolition when the M11 highway was planned, extending from Wanstead to Hackney, in order to connect existing highways. Ancient woods were to be razed, up to 350 homes torn down, and thousands of people moved in order to accommodate a six-lane highway designed to shave six minutes off previous travel times. In spite of spirited opposition, the project went ahead in 1994.

Though Canada did not develop long-distance divided highways to the same extent (the 1948 federal law mandating a Trans-Canada Highway catered to the lowest common denominator by supporting nothing more than a two-lane, paved road), various provinces did invest in the construction of highways, both for travel between cities and within cities. As in the United States, this led to the razing of some neighbourhoods. For instance, in Quebec City, the local Chinatown was almost entirely displaced by the construction of the Dufferin-Montmorency Highway in the early 1970s.

[Ingrid Peritz, "'Chinatown is gone, gone to heaven'", *The Globe and Mail* (17 June 2006), p. A3.]

It is estimated the entire United States now has over 6 million kilometres of public roads (and counting). Their combined surface is about 1 per cent of that country's land area, the equivalent of a state like South Carolina. As a consequence, these roads—in addition to the dividing strips, shoulders and ditches often found alongside them—have become a major ecological force.

Roads divert streams and drainage, changing water tables. They are conduits for the emission of carbon dioxide, ozone, and smog, as well as smaller quantities of heavy metals and toxic dusts. The heavy elements can grow to surprising concentrations in the higher plants, while the dust is enough to kill lichens and mosses. The roadside, even when it is not dosed with herbicides or kept cropped mechanically, is an environment all its own, often harsh and open to plants quite different from the dominant species of the neighbouring area (if only because the seeds of common weeds are spread by cars and trucks).

In the U.S. Northeast, where salt is abundantly used on driveways, parkings, and roads, chloride concentrations (salinity) in streams rise during the winter, up to a quarter of typical values for seawater.

In wooded areas or when a road cuts through a wilderness, the habits of wild animals are disrupted. Roads divide up habitats into smaller, more isolated parts, and the vehicles using them produce enough noise to drown out the more subtle cues used by wildlife. In Alaska, caribou will sometimes migrate along cleared roads, exposing themselves to trucks and predators. In North Carolina, black bears move away from busy roads, just like grizzlies in the Rockies. Most dramatically, roads kill the unwary animal trying to cross them. As early as the 1960s, it was estimated that a million animals a day were dying on the pavement of North American roads, including amphibians, birds, and mammals—but excluding insects. Unsurprisingly, vultures flock to roadsides to take advantage of the abundance of carrion.

On the whole, landscape ecologist Richard Forman from Harvard University estimates that the ecology of 20% of the United States is directly affected by the presence of roads. Most obviously, while roads as artefacts have an impact, they also provide access. When they reach into wilderness areas, they may allow for tourism and resource exploitation (logging, mining) to affect previously untouched areas.

Still, the human environment has been most obviously affected by automobiles. Outside the old cities and their downtowns once designed for pedestrians and horse-drawn carriages, a new landscape has been developed to host aliens: four-wheeled vehicles massing hundreds of kilograms that go everywhere from the home to the workplace or the shop. Asphalt or concrete roads have been laid down, shopping centres have replaced main street shops, parkings have multiplied, and gas stations or garages have popped up everywhere. Increasingly, people live and work without entering the downtown cores, sometimes commuting from one far-flung suburb to another.

The fuel demand of cars translates into the need for a world-spanning infrastructure, leading from oil wells to local gas stations. It is estimated that only 13% of the average modern car's fuel energy actually turns the wheels, the rest being lost as waste heat, friction, and noise, or being used to power accessories or idling.

As a result, modern cities sprawl, strip malls (and car dealerships) colonize freeway exits and suburban boulevards, and the air grows hazy with a new kind of smog. While the massive resources (glass, steel, rubber, electronics) invested in each automobile end up in dumps or need to be recycled.

The modern suburb, served by automobiles and not by streetcars or railway like some suburbs in the early 20th century, is a creation of the car. There is some debate as to the role played by car and tire manufacturers in buying up streetcar companies and offering instead bus service, a switch that led to the disappearance of streetcar tracks in cities and the opening of city streets to... car traffic. What is not arguable is the expense, both in primary resources (metal, plastics, oil, wood, concrete) and in secondary resources (land, diverse ecosystems), that is consumed by suburbs requiring large infrastructure improvements (paved streets, sewers, streetlights, sidewalks eventually) serving a relatively low number of people per square kilometre.

Challenge: Assuming that (as seems likely) the cost of oil continues shooting up as reserves dwindle and that no energy source adequate to the needs of personal transportation replaces oil in the medium term, where do you think land values will increase the most? In downtowns or in suburbs?

Film: *Modern Times*

Made in 1936, the movie's opening scenes reflect the impact made on the public by the new mechanized factories typical of Fordism and of mass production. Of course, Chaplin's factory is somewhat stylized: everything is clean and roomy, the machinery is streamlined, the in-house picture phones are far ahead of what was available at the time, and it is rather unclear what the factory is making. Nevertheless, many aspects in these sequences match what were seen to be significant novelties in mass production workplaces: the worker punches a time card to come in or to go to the bathroom, the worker is reduced to a single task (tightening bolts) that is seen as mind-numbing, the worker is supervised by a foreman (or line boss), the speed of the worker is controlled (by the assembly line's pace instead of a stopwatch, but also by the boss who controls the assembly line), and the worker can no longer "soldier" or take some time off without being called to order. In the opening shot, Chaplin draws a parallel between a herd of sheep and the masses of men going to work. In the movie's most famous sequence, Chaplin's character throws himself inside the machine, illustrating the man who's become a cog and part of the machine, trapped in the *enmeshing* gears. Mechanization is pushed to extremes in the case of the "eating machine" and, when Chaplin's character goes mad and suffers a nervous breakdown, he is told to avoid excitement. The next shot shows the frenzied streets of an American metropolis…

Finally, in the last part of the movie, when Chaplin's character goes back to the factory, he is the assistant of a skilled mechanic who is still entitled to bring what seems to be his own tools to work (which may have been anachronistic) and who, like his assistant earlier, gets caught in the gears of a machine. In short: both the unskilled worker and the skilled one were at the mercy of the new system.

D. The Human Use of Human Beings

Part of the mass production system was the classification of human beings. Taylor had already advocated studying "the character, the nature, and the performance" of every worker. The Ford system went further. Employees were given the jobs they seemed best fitted for. In this respect, Ford was at the forefront of his era's belief in human classification.

This belief drew on developments on several fronts.

Oldest of all was the rise of scientific racism, dating back to the eighteenth century. European scientists had encountered people who were unlike them. In the spirit of the Scientific Revolution, some applied to the science of humans the same methods used by the biologists who classified plants, insects or animals. They identified salient traits, measured them or counted them, correlated them with other traits, noticed which ones went together most often, and then inferred that one trait followed from the other. And so they felt able to draw general conclusions from the observations of a single thing. Such classifications yielded reasonably trustworthy results in chemistry or botany, but they sometimes generated basic confusions. However, making mistakes with the proper classification of chemical compounds or ferns was far less serious than when it involved human beings...

Nevertheless, Western anthropologists and psychologists at the turn of the twentieth century still felt confident they knew how to classify people. Their assertions fed the contemporary passion for intelligence measurements, symbolized by the vogue of the IQ (Intelligence Quotient) test. By then, the IQ test proper had outgrown its origins in psychiatry and child pedagogy to be applied to immigrants to America and to soldiers during World War I.

Originally, French psychologist Alfred Binet (1857-1911) had designed a test intended to identify children whose lack of success in normal classrooms suggested the need for remedial measures or special education. A first version of the test was published in 1905, but it was the 1908 version that assigned an age level to each task. (In 1912, German psychologist W. Stern argued that mental age should be divided by chronological age, thus yielding an *intelligence quotient*.) Importantly, since Binet believed that special education could improve a child's performance, the Binet test did <u>not</u> measure some fixed, innate mental ability. The test was concerned with identifying children who needed help, not ranking normal children—or adults.

In the United States, H. H. Goddard extended the Binet test to adults and to immigrants. By 1913, physicians working at the Ellis Island immigration centre in New York were using his version of the intelligence test to reject "feeble-minded" immigrants.

This was the era of eugenics and New York was also the home of the Cold Spring Harbor Laboratory from 1904 to 1939, the base of the Eugenics Record Office and the headquarters of a national movement to improve the human race through selective breeding. *Eugenicists* at Cold Spring and elsewhere believed that the unfit had to be prevented from passing on their defective genes for blindness, criminality, insanity, and stupidity. They often expressed the wish that they could sterilize the "submerged tenth", the most unfit 10 percent of the population, but first it was necessary to identify them. The extended intelligence tests could be applied to the identification of stupidity. Keeping out undesirable immigrants was also part of the eugenic agenda.

Eugenics was considered to be progressive. It was based on the newly emerging science of genetics and on the work of Francis Galton, a cousin of Charles Darwin. Eugenics was embraced by universities, funded by major endowments, and endorsed by the U.S. Supreme Court. In some U.S. states and Canadian provinces, doctors and mental institutions were authorized by law to sterilize people they judged to be unfit to pass on their genes (in some cases, their patients were mostly guilty of being poor and ignorant, or of being the wrong race). In other cases, doctors overseeing patients interned in asylums and prisons are suspected of having conducted experiments on behalf of eugenicists.

In 1916, Lewis M. Terman carried out his own revision of the Binet test, by increasing the number of tasks and by extending the scale from mid-teenage years to "superior adults". He also advocated generalized testing and believed in matching jobs to the abilities of test subjects, even when the latter are of inferior intelligence:

"The evolution of modern industrial organization together with the mechanization of processes by machinery is making possible the larger and larger utilization of inferior mentality. One man with ability to think and plan guides the labor of ten or twenty laborers, who do what they are told to do and have little need for resourcefulness or initiative."

This statement by Terman in 1919 came after the systematic testing of almost two million adult men by Robert M. Yerkes in the army camps set up by the United States during its participation in World War I. The goal had been to build up a copious, useful, and uniform body of data that would set the art of intelligence measurement on a firmer footing. The tests used by Yerkes and his psychologists were the first mass-produced written tests of intelligence. The default written text was known as the Alpha test, while a more pictorial version for illiterates was known as the Beta test. According to the results of these tests, the psychologists graded each man from A to E, with plusses and minuses.

The first wave of U.S. psychologists testing for intelligence tended to believe that intelligence was both strongly congenital and an innate quantity fixed for life. Ford's system was not so rigid, but it still tended to slot people into ready-made places just like car parts were to be fitted into their assigned places. Even though Ford did not use the IQ test, he obviously believed that there were distinct types of people.

The incipient association of native intelligence and work ability is more obvious in British author Aldous Huxley's utopian satire of 1932, where the far future has been shaped by the precepts of Henry Ford to the point of creating different kinds of humans (designated by Greek letters according to their level of intelligence). The excerpts provided hereafter, taken from Huxley's novel and from Ford's autobiography, may be compared for what they have in common. The excerpt from French writer Céline affords us a bird's-eye view of a Ford factory in Detroit just after World War I. It also dates from the thirties, when people in many countries felt that something new had come into the world along with Fordism, but the more recent excerpt from U.S. writer Jeffrey Eugenides depicts the experience of workers inside the Ford Rouge plant in a very literary style.

* Documents *

Aldous Huxley, *Brave New World* (1932)

***** And, in effect, eighty-three almost noseless black brachycephalic Deltas were cold-pressing. The fifty-six four-spindle chucking and turning machines were being manipulated by fifty-six aquiline and ginger Gammas. One hundred and seven heat-conditioned Epsilon Senegalese were working in the foundry. Thirty-three Delta females, long-headed, sandy, with narrow pelvises, and all within 20 millimetres of 1 metre 69 centimetres tall, were cutting screws. In the assembling room, the dynamos were being put together by two sets of Gamma-Plus dwarfs. The two low work-tables faced one another; between them crawled the conveyor with its load of separate parts; forty-seven blond heads were confronted by forty-seven brown ones. Forty-seven snubs by forty-seven hooks; forty-seven receding by forty-seven prognathous chins. The completed mechanisms were inspected by eighteen identical curly auburn girls in Gamma green, packed in crates by thirty-four short-legged, left-handed male Delta-Minuses, and loaded into the waiting trucks and lorries by sixty-three blue-eyed, flaxen and freckled Epsilon Semi-Morons. [...]
'And I assure you,' the Human Element Manager concluded, as they left the factory, 'we hardly ever have any trouble with our workers. We always find...'

Henry Ford, *My Life and Work* (1929)

***** Repetitive labour—the doing of one thing over and over again and always in the same way—is a terrifying prospect to a certain kind of mind. It is terrifying to me. I could not possibly do the same thing day in and day out, but to other minds, perhaps I might say to the majority of minds, repetitive operations hold no terrors. In fact, to some types of mind thought is absolutely appalling. To them the ideal job is one where the creative instinct need not be expressed. The jobs where it is necessary to put in mind as well as muscle have very few takers—we always need men who like a job because it is difficult. The average worker, I am sorry to say, wants a job in which he does not have to think. Those who have what might be called the creative type of mind and who thoroughly abhor monotony are apt to imagine that all other minds are similarly restless and therefore to extend quite unwanted sympathy to the labouring man who day in and day out performs almost exactly the same operation...

* The kind of mind that does not like repetitive work does not have to stay in it. The work in each department is classified according to its desirability and skill into Classes "A", "B", and "C", each class having anywhere from ten to thirty different operations. A man comes directly from the employment office to "Class C". As he gets better he goes into "Class B", and so on into "Class A", and out of "Class A" into tool making or some supervisory capacity.

(*In English*:)
Jeffrey Eugenides, *Middlesex* **(2002)**

Historical fact : people stopped being human in 1913. That was the year Henry Ford put his cars on rollers and made his workers adopt the speed of the assembly line. At first, workers rebelled. They quit in droves, unable to accustom their bodies to the new pace of the age. Since then, however, the adaptation has been passed down: we've all inherited it to some degree, so that we plug right into joysticks and remotes, to repetitive motions of a hundred kinds.

But in 1922 it was still a new thing to be a machine.

On the factory floor, my grandfather was trained for his job in seventeen minutes. Part of the new production method's genius was its division of labor into unskilled tasks. That way you could hire anyone. And fire anyone. The foreman showed Lefty how to take a bearing from the conveyor, grind it on a lathe, and replace it. Holding a stopwatch, he timed the new employee's attempts. Then, nodding once, he led Lefty to his position on the Line. On the left stood a man named Wierzbicki; on the right, a man named O'Malley. For a moment, they are three men, waiting together. Then the whistle blows.

Every fourteen seconds Wierzbicki reams a bearing and Stephanides grinds a bearing and O'Malley attaches a bearing to a camshaft. The camshaft travels away on a conveyor, curling around the factory, through its clouds of metal dust, its acid fogs, until another worker fifty yards on reaches up and removes the camshaft, fitting it onto the engine block (twenty seconds). Simultaneously, other men are unhooking parts from adjacent conveyors—the carburetor, the distributor, the intake manifold—and connecting them to the engine block. Above their bent heads, huge spindles pound steam-powered fists. No one says a word. Wierzbicki reams a bearing and Stephanides grinds a bearing and O'Malley attaches a bearing to a camshaft. The camshaft circles around the floor until a hand reaches up to take it down and attach it to the engine block, growing increasingly eccentric now with swooshes of pipe and the plumage of fan blades. Wierzbicki reams a bearing and Stephanides grinds a bearing and O'Malley attaches a bearing to a camshaft. While other workers screw in the air filter (seventeen seconds) and attach the starter motor (twenty-six seconds) and put on the flywheel. At which point the engine is finished and the last man sends it away...

Except that he isn't the last man. There are other men below hauling the engine in, as a chassis rolls out to meet it. These men attach the engine to the transmission (twenty-five seconds). Wierzbicki reams a bearing and Stephanides grinds a bearing and O'Malley attaches a bearing to a camshaft. My grandfather sees only the bearing in front of him, his hands removing it, grinding it, and putting it back as another appears. The conveyor over his head extends back to the men who stamp out the bearings and load ingots into the furnaces; it goes back to the Foundry where the Negroes work, goggled against the infernal light and heat. They feed iron ore into the Blast Oven and pour molten steel into core molds from ladles. They pour at just the right rate—too quickly and the molds will explode; too slowly and the steel will harden. They can't stop even to pick the burning bits of metal from their arms. Sometimes the foreman does it; sometimes not. The Foundry is the deepest recess of the Rouge, its molten core, but the Line goes back farther than that. It extends outside to the hills of coal and coke; it goes to the river where freighters dock to unload the ore, at which point the Line becomes the river itself, snaking up to the north woods until it reaches its source, which is the earth itself, the limestone and sandstone therein; and then the Line leads back again, out of substrata to river to freighters and finally to the cranes, shovels, and furnaces where it is turned into molten steel and poured into molds, cooling and hardening into car parts—the gears, drive shafts, and fuel tanks of 1922 Model T's. Wierzbicki reams a bearing and Stephanides grinds a bearing and O'Malley attaches a bearing to a camshaft. Above and behind, at various angles, workers pack sand into core molds, or hammer plugs into molds, or put casting boxes into the cupola furnace. The Line isn't a single line but many, diverging and intersecting. Other workers stamp out body parts (fifty seconds), bump them (forty-two seconds), and weld the pieces together (one minute and ten seconds). Wierzbick reams a bearing and Stephanides grinds a bearing and O'Malley attaches a bearing to a camshaft. The camshaft flies around the factory until a man unhooks it, attaches it to the engine block, growing eccentric now with fan blades, pipes, and spark plugs. And then the engine is finished. A man sends it dropping down onto a chassis rolling out to meet it, as three other workers remove a car body from the oven, its black finish baked to a shine in which they can see their own faces, and they recognize themselves, momentarily, before they drop the body onto the chassis rolling out to meet it. A man jumps into the front seat (three seconds), turns the ignition (two seconds), and drives the automobile away.

(pp. 95-97)

(***In French*:**)
Céline, *Voyage au bout de la nuit* **(1932)**

Et j'ai vu en effet des grands bâtiments trapus et vitrés, des sortes de cages à mouches sans fin, dans lesquelles on discernait des hommes à remuer, mais remuer à peine, comme s'ils ne se débattaient plus que faiblement contre je ne sais quoi d'impossible. C'était ça Ford? Et puis tout autour et au-dessus jusqu'au ciel un bruit lourd et multiple et sourd de torrents d'appareils, dur, l'entêtement des mécaniques à tourner, rouler, gémir, toujours prêtes à casser et ne cassant jamais.

"C'est donc ici que je me suis dit… C'est pas excitant…" C'était même pire que tout le reste. Je me suis approché de plus près, jusqu'à la porte où c'était écrit sur une ardoise qu'on demandait du monde.

J'étais pas le seul à attendre. Un de ceux qui patientaient là m'a appris qu'il y était lui depuis deux jours, et au même endroit encore. Il était venu de Yougoslavie, ce brebis, pour se faire embaucher. Un autre miteux m'a adressé la parole, il venait bosser qu'il prétendait, rien que pour son plaisir, un maniaque, un bluffeur.

Dans cette foule presque personne ne parlait l'anglais. Ils s'épiaient entre eux comme des bêtes sans confiance, souvent battues. […]

Il pleuvait sur notre petite foule. Les files se tenaient comprimées sous les gouttières. C'est très compressible les gens qui cherchent du boulot. Ce qu'il trouvait bien chez Ford, que m'a expliqué le vieux Russe aux confidences, c'est qu'on y embauchait n'importe qui et n'importe quoi. […]

C'était vrai, ce qu'il m'expliquait qu'on prenait n'importe qui chez Ford. Il avait pas menti. Je me méfiais quand même parce que les miteux ça délire facilement. […]

À poil qu'on nous a mis pour commencer, bien entendu. La visite ça se passait dans une sorte de laboratoire. Nous défilions lentement. "Vous êtes bien mal foutu, qu'a constaté l'infirmier en me regardant d'abord, mais ça fait rien."

Et moi qui avais eu peur qu'ils me refusent au boulot à cause des fièvres d'Afrique, rien qu'en s'en apercevant si par hasard ils me tâtaient les foies! Mais au contraire, ils semblaient l'air bien content de trouver des moches et des infirmes dans notre arrivage.

— Pour ce que vous ferez ici, ça n'a pas d'importance comment que vous êtes foutu! m'a rassuré le médecin examinateur, tout de suite.

— Tant mieux que j'ai répondu moi, mais vous savez, monsieur, j'ai de l'instruction et même j'ai entrepris autrefois des études médicales…

Du coup, il m'a regardé avec un sale œil. J'ai senti que je venais de gaffer une fois de plus, et à mon détriment.

— Ça ne vous servira à rien ici vos études, mon garçon! Vous n'êtes pas venu ici pour penser, mais pour faire les gestes qu'on vous commandera d'exécuter… Nous n'avons pas besoin d'imaginatifs dans notre usine. C'est de chimpanzés dont nous avons besoin… Un conseil encore. Ne nous parlez plus jamais de votre intelligence! On pensera pour vous mon ami! Tenez-vous-le pour dit.

[…] Une fois rhabillés, nous fûmes répartis en files traînardes, par groupes hésitants en renfort vers ces endroits d'où nous arrivaient les fracas énormes de la mécanique. Tout tremblait dans l'immense édifice et soi-même des pieds aux oreilles possédé par le tremblement, il en venait des vitres et du plancher et de la ferraille, des secousses, vibré de haut en bas. On en devenait machine aussi soi-même à force et de toute sa viande encore tremblotante dans ce bruit de rage énorme qui vous prenait le dedans et le tour de la tête et plus bas vous agitant les tripes et remontait aux yeux par petits coups précipités, infinis, inlassables. À mesure qu'on avançait on les perdait les compagnons. On leur faisait un petit sourire à ceux-là en les quittant comme si tout ce qui se passait était bien gentil. On ne pouvait plus ni se parler ni s'entendre. Il en restait à chaque fois trois ou quatre autour d'une machine.

On résiste tout de même, on a du mal à se dégoûter de sa substance, on voudrait bien arrêter tout ça pour qu'on y réfléchisse, et entendre en soi son cœur battre facilement, mais ça ne se peut plus. Ça ne peut plus finir. Elle est en catastrophe cette infinie boîte aux aciers et nous on tourne dedans et avec les machines et avec la terre. Tous ensemble! Et les mille roulettes et les pilons qui ne tombent jamais en même temps avec des bruits qui s'écrasent les uns contre les autres et certains si violents qu'ils déclenchent autour d'eux comme des espèces de silences qui vous font un peu de bien.

Le petit wagon tortillard garni de quincaille se tracasse pour pousser entre les outils. Qu'on se range! Qu'on bondisse pour qu'il puisse démarrer encore un coup le petit hystérique. Et hop! il va frétiller plus loin ce fou clinquant parmi les courroies et volants, porter aux hommes leurs rations de contraintes.

Les ouvriers penchés soucieux de faire tout le plaisir possible aux machines vous écœurent, à leur passer les boulons au calibre, et des boulons encore, au lieu d'en finir une fois pour toutes, avec cette odeur d'huile, cette buée qui brûle les tympans et le dedans des oreilles par la gorge. […] Mes minutes, mes heures, mon reste de temps comme ceux d'ici s'en iraient à passer des petites chevilles à l'aveugle d'à côté qui les calibrait, lui, depuis des années les chevilles, les mêmes. Moi j'ai fait ça tout de suite très mal. On ne me blâma point, seulement après trois jours de ce labeur initial, je fus transféré, raté déjà, au trimbalage du petit chariot rempli de rondelles, celui qui cabotait d'une machine à l'autre. Là, j'en laissais trois, ici douze, là-bas cinq seulement. Personne ne me parlait. On existait plus que par une sorte d'hésitation entre l'hébétude et le délire. Rien n'importait que la continuité fracassante des mille et mille instruments qui commandaient les hommes.

(pp. 285-289)