HIS 2129

Technology, Society and Environment since 1800

(Winter 2014)

In the Year of Our Ford: The Automobile Era

- The modern automobile emerged quickly once a sufficiently light and powerful motor came into being with the Otto internal combustion engine
- Though the invention of the Diesel engine followed rapidly, early automobiles mostly experimented with the Otto engine, steam engines, and electric motors
- Most early developments happened in Europe, but Henry Ford pioneered the mass production of cars in the United States
- Ford did not invent the assembly line, interchangeable parts, the division of labour, or the mechanization of human work, but he was the first to market cheap cars mass produced by combining all of these features

Cars and Mass Production

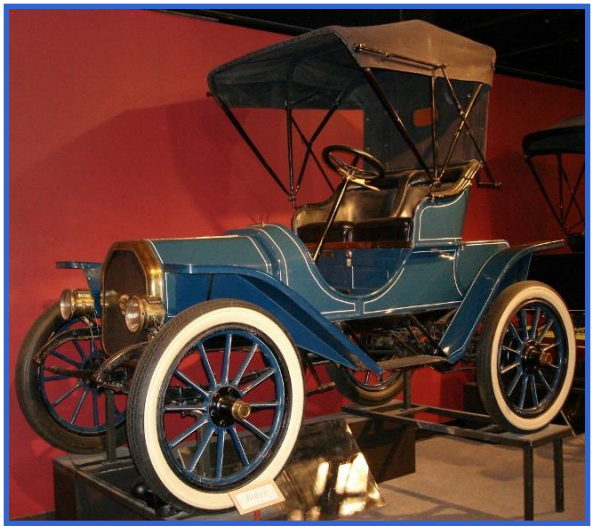
- The early development of automobiles
- The scientific age: from scientific management to mass production
- Henry Ford and the mass marketing of cars
- The rise of the automobile society
- Mobility under extreme conditions
- Mass production and mass mobility

The Car: Early Contenders...

- Walter C. Baker and his partner F. Philip Dorn built their first electric-powered car in 1897, and founded the Baker Motor Vehicle Company in Cleveland the next year; Baker electric cars were produced until 1916
- In 1899, a Belgian electric car—Camille Jenatzy's "Jamais Contente"—set a land speed record of 106 km/h
- In 1902, a French steam car—Léon Serpollet's "L'Œuf de Pâques"—set a new speed record of 121 km/h (Serpollet received what may be the world's first automobile driving licence in 1889)
- In North America, the Stanley Automobile Manufacturing Company produced steam-powered cars from 1897 to 1927; in 1906, a specially-designed Stanley "Steamer" set a world speed record of 204 km/h

Early Electric Cars

1910 Baker runabout, claimed range of 120 km
(MOST, Ottawa) ➔



Camille Jenatzy's "*Jamais Contente*", a specially designed electric racer

A refurbished 1912 Baker electric car (a production model) ➔

Electric Trucks in the U.S.

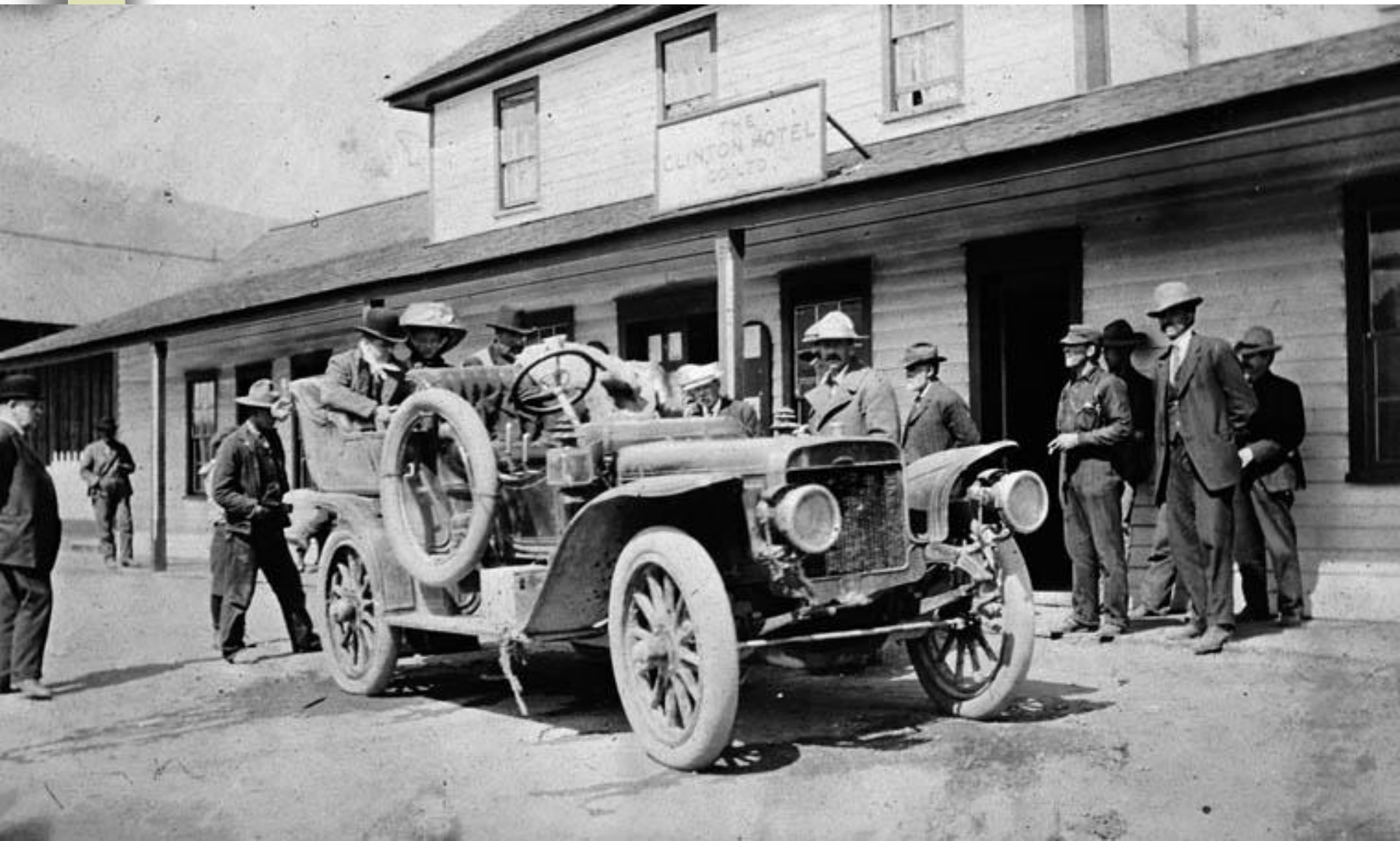
Well into the 1920s, companies distributing goods within U.S. cities (ice, coal, beer) and also Edison's electric supply companies (as late as 1947) used electric trucks; they were cheaper per unit distance, though not per unit payload. In 2010, GE announced an order of 25,000 electric vehicles to be delivered by 2015 (half from GM) for its own fleet and for its leasing business.

Truck fleets of Edison cos., 1912	N.Y.	Chicago	Philadelphia	St. Louis	Boston	K.C.	Baltimore	TOTAL
Horse-drawn	**4**	**113**	**44**	**39**	**95**	**24**	**85**	**404**
(%)	***3.7***	***56.8***	***41.9***	***55.7***	***53.7***	***75***	***72.6***	***50.0***
Electric	**103**	**70**	**35**	**21**	**44**	**5**	**15**	**293**
(%)	***95.4***	***35.2***	***33.3***	***30.0***	***24.9***	***15.6***	***12.8***	***36.3***
Gasoline	**1**	**16**	**26**	**10**	**38**	**3**	**17**	**111**
(%)	***0.9***	***8***	***24.8***	***14.3***	***21.5***	***9.4***	***14.5***	***13.7***
Total	**108**	**199**	**105**	**70**	**177**	**32**	**117**	**808**

From: Gijs P. A. Mom and David A. Kirsch, "Technologies in Tension", *Technology and Culture* (2001); *Globe and Mail* (12/11/2010)

A Stanley Steamer in Clinton (BC) around 1900

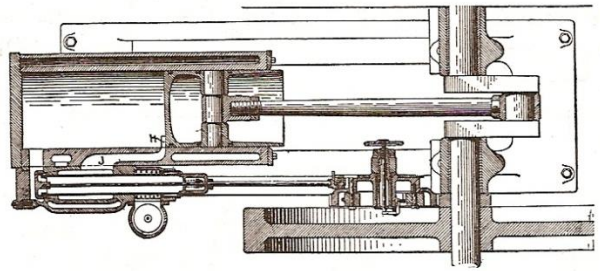
James J. Talman, Archives Canada



Internal versus External Combustion

And the winner…

- A steam engine is an "external combustion" motor: the source of heat (gasoline in steam cars) is applied outside the cylinder, turning water into steam—expansion against the piston and condensation is controlled by moving steam in and out
- An "internal combustion" motor produces heat within the cylinder—expansion against the piston is produced by firing the gas with an electric spark



423. SECTIONAL PLAN OF A GASOLINE ENGINE.—Four-cycle type, with exhaust port opened by the piston at the end of the stroke, and continued exhaust through an annular valve around the inlet valve. The charge is heated and vaporized in the valve chamber by the exhaust. "Olin" model.

From: Gardner Dexter Hiscox, *Mechanical Movements and Devices* (1911, first edition in 1899)

The Buick McLaughlin Model D-45

A 1916 Touring Car using biogas

Archives Canada

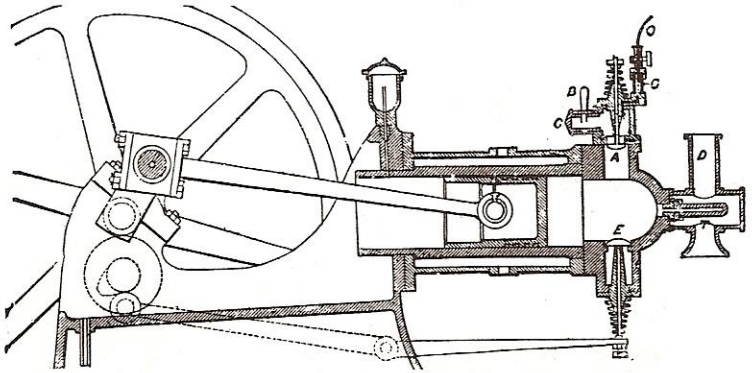
Ford's success forced other car makers to adapt. GM was created in 1908. Buick was one of the initial members of the group. In Canada, the independent Ontario company McLaughlin chose to partner with GM and stopped making its own designs in 1915. It turned out Canadian versions of the Buick and Chevrolet at its Oshawa plant before its buy-out by GM in 1918.

Straw Gas Research in Canada

- The extraction and applications of straw gas seem to have been developed in 1914 by engineer George Harrison of Moose Jaw and chemistry professor R. D. MacLaurin of the University of Saskatchewan in Saskatoon, following experiments and ideas reported by engineering professor Alexander Greig in a 1912 memo
- Some of their work was later replicated at the Arlington Experimental Farm of the United States Department of Agriculture, in Arlington (VA)

Gas and Gasoline

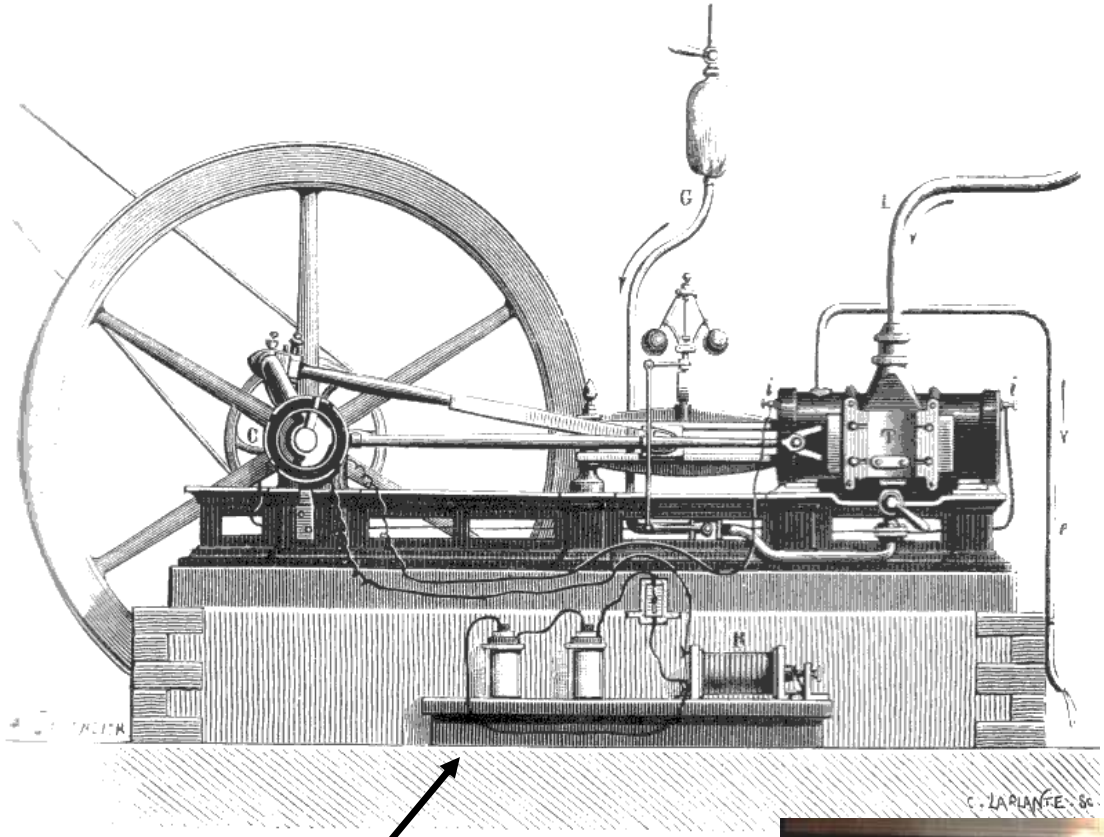
- One of the earliest effective gas motors was designed by Belgian Étienne Lenoir in 1859
- Gasoline derived from petroleum was burned in many internal combustion engines, but other fuels were tried and many engine designs early on



424. SIMPLE GAS OR GASOLINE ENGINE.—A, inlet valve; E, exhaust valve; gasoline enters by gravity at G, regulated by a faucet. Air enters at B by the suction of the piston, atomizing the gasoline as it drops into the air chamber. The tube igniter is heated by a gasoline burner beneath the bell mouth.

From: Gardner Dexter Hiscox, *Mechanical Movements and Devices* (1911, first edition in 1899)

Lenoir's Motor (patented in 1860)



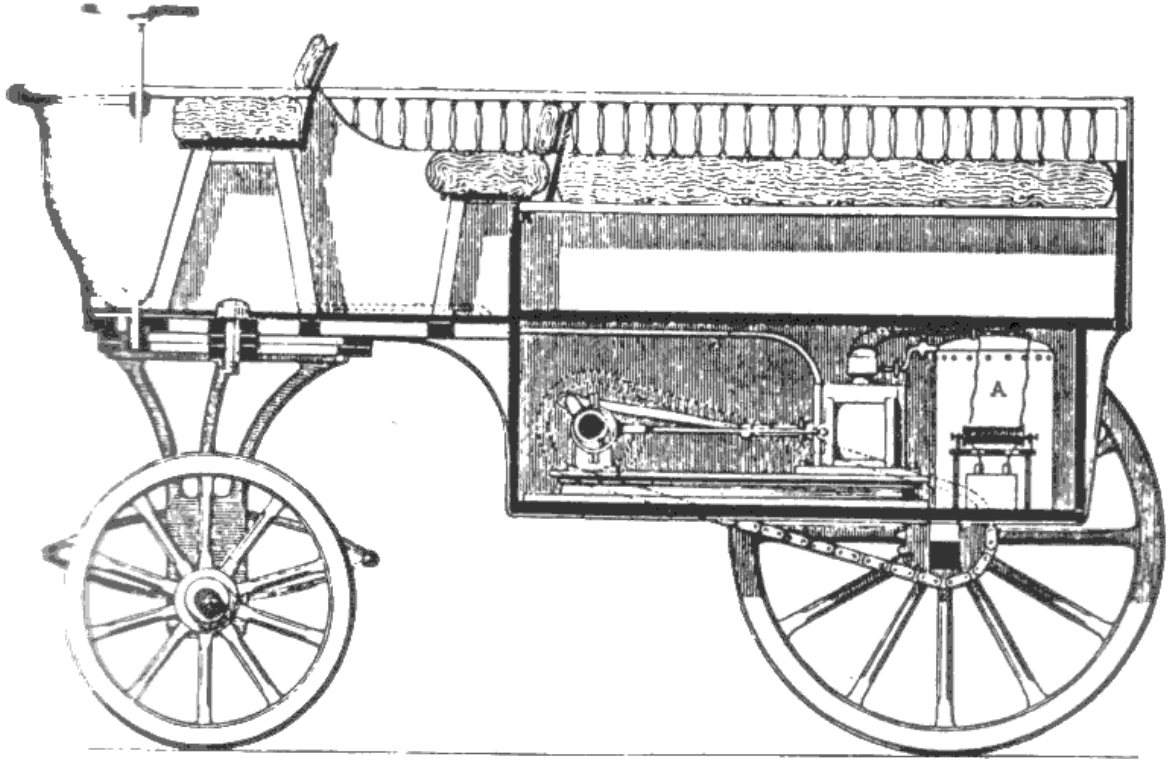
Lenoir's 1862 motor introduced a compressed mix of coal gas and air into the cylinder. A small electric spark set it off. It burned too much gas to be truly epoch-making.

Note the electric batteries and induction coil used for the required spark

Conservatoire national des arts et métiers, France

Lenoir's Motor Car (1863)

Lenoir's car used an improved version of his motor and resembled some of the early steam coaches built in France and Great Britain, going back to Cugnot. Aside from a couple of abortive schemes in England and Switzerland, it seems to have been the first working internal combustion car.



Historical Note: The first functional motor automobile is considered to be Joseph Cugnot's painfully slow steam tractor of 1769, but we have many designs for mechanical automobiles going back to Antiquity (Hero of Alexandria).

The German Breakthrough (1)

- In 1862, a versatile French engineer, Alphonse Beau de Rochas, patented the concept of the four-stroke engine, but he did not build a prototype
- German inventor Nikolaus August Otto (1832-1891) then patented a four-stroke engine using coal gas and used it as a stationary prime mover for factories
- One of his employees, Gottlieb Daimler (1834-1900), wished to replace coal gas with petroleum to improve the engine

The German Breakthrough (2)

- When Daimler couldn't come to an agreement with his employer, he quit in 1882
- Daimler patented a high-speed, four-stroke, petrol-fueled engine in 1885 and applied it to a four-wheel vehicle in 1886; as the money was in stationary engines, he did not build another car until 1889
- Karl Benz (1844-1929) built his first car in 1885-1886

First Generation German Cars

The Karl Benz automobile powered by an internal combustion engine and patented in 1886.

Gottlieb Daimler's 1885 motorcycle

Gottlieb Daimler's 1886 motor carriage

Early Internal Combustion Cars in North America

Library of Congress

The “horseless buggy” of Charles E. and J. Frank Duryea (1893)

The disappearance of barn animals from North American city streets made it possible for cars to answer the growing need for more urban transportation solutions.

Two men in a De Dion # 2 (1901)

Library of Congress

Vancouver (BC) fire department automobiles in front of the post office (1910)

W. J. Carpenter, British Library

To recapitulate (1)

- Did electric cars hold any 19th-century speed records? Yes 1899 “J. C.”
- How long did some of the Edison companies hang on to their electric trucks? 27years
- Was gasoline the only fuel used in early internal combustion engines? No, coal gas and biogas, strew gas
- In what country were the first practical and commercial vehicles driven by internal combustion engines built? England and Switzerland?
- Did Henry Ford invent standardized interchangeable parts? NO, but he used it.

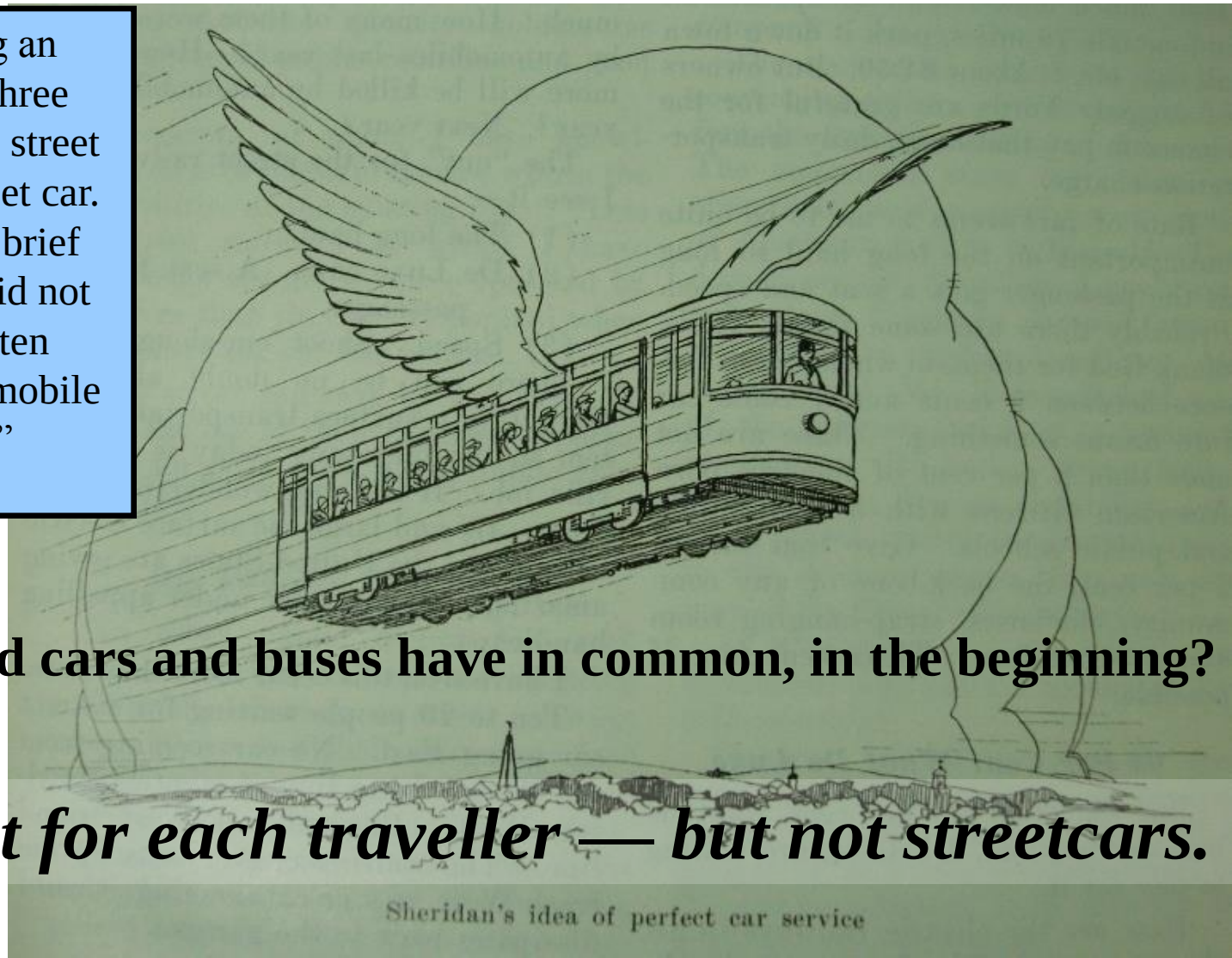
Car meets streetcar in front of the E. B. Eddy Co. in Hull, QC (1914)

William James Topley (1845-1930), Archives Canada

Car, streetcars, and buses: Was it a fair fight?

AERA, August 1925, p. 7.

"Since I have been using an automobile I chafe at a three or five minute wait for a street car. I appreciate the street car. Just the same, I chafe at brief waits for street cars. I did not chafe at waits of five or ten minutes before the automobile gave me instant service."
AERA, August 1925, p. 6.



What did cars and buses have in common, in the beginning?

A seat for each traveller — but not streetcars.

The Scientific Age

- Factories long had little to do with science, but efficiency experts of the early 20th century claimed to have found the “scientific” principles of manufacturing
- Older methods such as the use of (dis)assembly lines were combined with time and motion studies to yield more productivity
- Henry Ford’s engineers applied many of these techniques to the mass production of cars, achieving production in quantity at such low cost that all their competitors either adopted the same methods, specialized, or went under

Fordism
as seen by a Broadway musical…

- *See my people? Well, here's my theory*
- *Of what this country is moving toward:*
- *Every worker a cog in motion.*
- *Well, that's the notion of Henry Ford.*
- *One man tightens and one man ratchets*
- *And one man reaches to pull one cord.*
- *Car keeps movin' in one direction.*
- *A genuflection to Henry Ford!*
- *(Speed up the belt, speed up the belt, Sam!)*
- *Mass production will sweep the nation,*
- *A simple notion the world's reward.*
- *Even people who ain't too clever*
- *Can learn to tighten a nut forever,*
- *Attach one pedal or pull one lever . . .*

Ragtime (1996)

Assembly line at the Chrysler plant (Windsor, ON, Sept. 1953)

Archives Canada

The Human Use of Human Beings

- One key part of the mass production system was the classification of human beings according to the tasks they were expected to carry out
- This drew on both scientific racism (going back to the 18th century), which believed in innate differences between human beings, and the more recent rise of intelligence testing pioneered by Alfred Binet (1857-1911)
- By the early 20th c., scientific racism and the I.Q. test had become key building blocks of the belief in *eugenics*

Measuring intelligence

- **Alfred Binet** (1857-1911), head of a psychology laboratory at the Sorbonne in Paris, designed a set of empirical tests (1905, 1908, 1911) to identify young schoolchildren in need of specialized education by ascertaining their “mental age”
- In 1912, German psychologist W. Stern creates the intellectual quotient (I.Q.)
- In the United States, H. H. Goddard turns the tests into an instrument for measuring innate and inheritable intelligence

Testing to classify

- In 1917, **Robert M. Yerkes**, Harvard psychology professor, convinces the U.S. government to get all Army recruits to pass two versions (Alpha and Beta) of an aptitude test
- The tests will be used to give the students marks ranging from A to E (with added + and - notes)
- A C- will designate a low normal intelligence, making the subject fit for private; a D will show that the person is rarely able to complete tasks requiring special ability, foresight, cleverness or sustained attention
- The D and E are assumed to show that the person cannot read and will not understand written instructions

Contradictory results

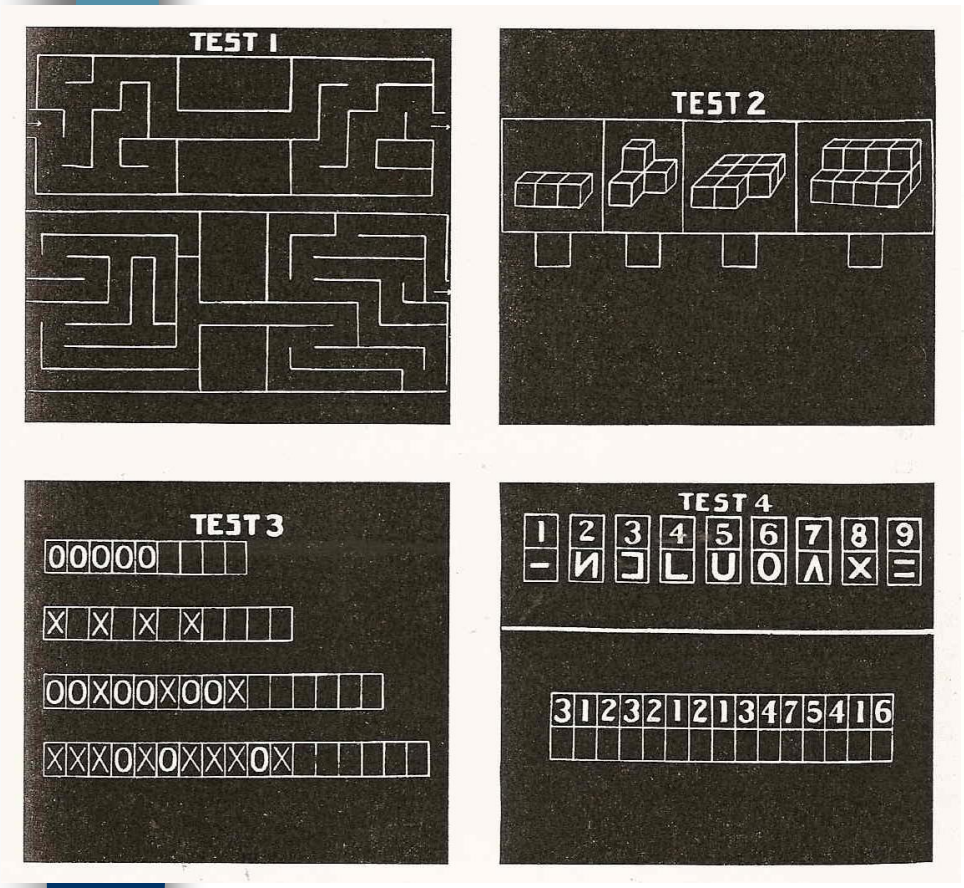
- The team assembled by Yerkes will attempt to test two million men, but army officers are hostile and the testing conditions far from optimal
- Still, a sample of 160,000 individuals is analyzed in detail and Yerkes will conclude in 1921 that
  - the mental age of the average white adult is just above 13 years, hardly more than the typical “moron”
  - the average immigrant is a moron when he’s from Eastern or Southern Europe (Russia, Poland, Italy), but not if he speaks English or if he’s from a German or Scandinavian country
  - the average black adult is less intelligent than all the rest, at the very bottom of the intellectual scale

Some factors…

- Due to lack of time, the Alpha version is sometimes given to the illiterate when it is intended for the literate only
- Questions require a certain level of culture and knowledge of life in the United States (what is Crisco? who is Christy Mathewson?)
- In fact, mental age increases as a function of time spent in the United States
- Even the non-verbal test for illiterates is not neutral

Time spent in the U.S. (years)	Average mental age
0-5	11,29
6-10	11,70
11-15	12,53
16-20	13,50
20 or more	13,74

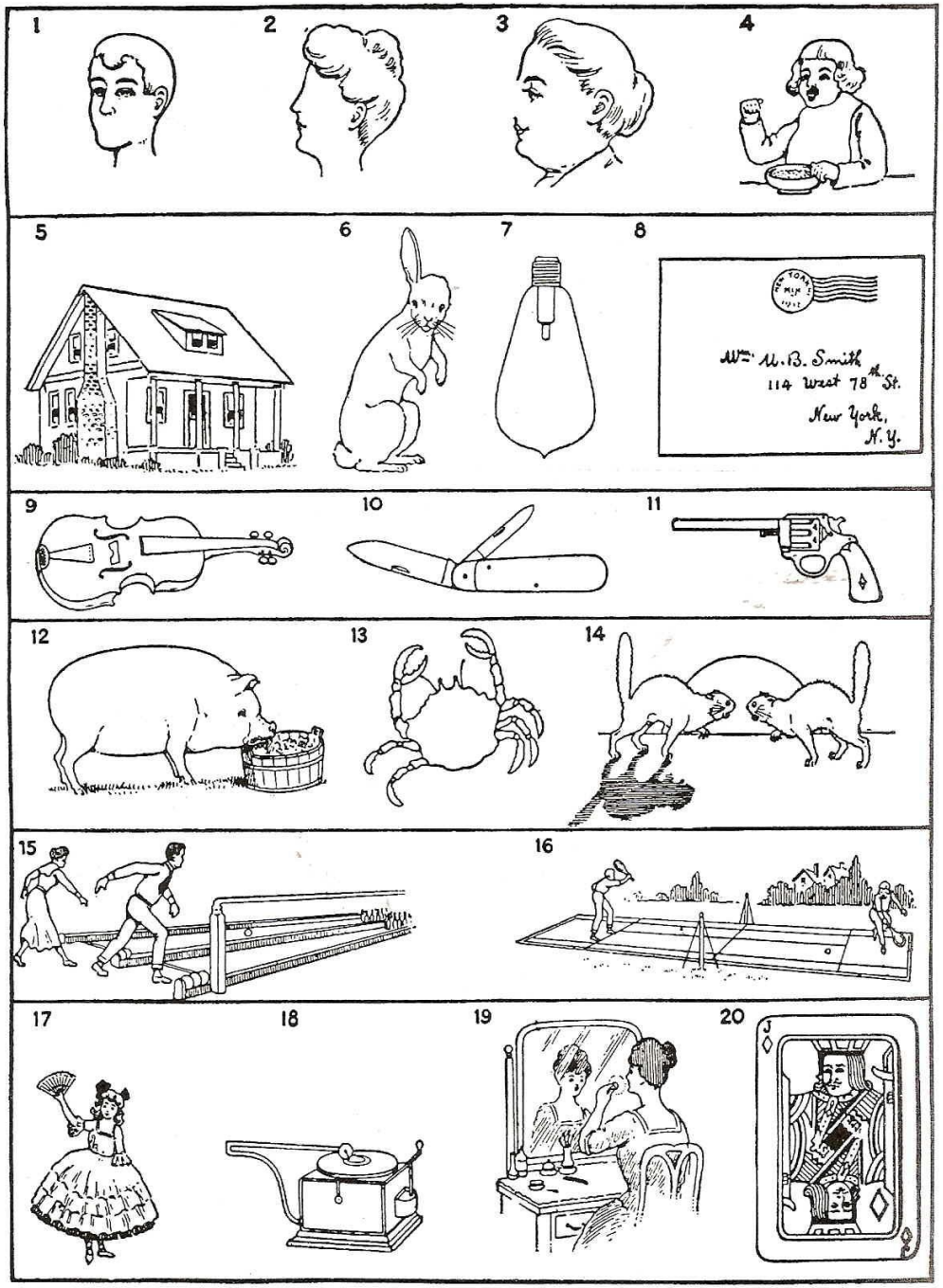
The tests used by Yerkes in 1917



The seven parts of the Beta test were first drawn on a blackboard, giving these examples of each type of questions. Examples were explained by speaking and miming.

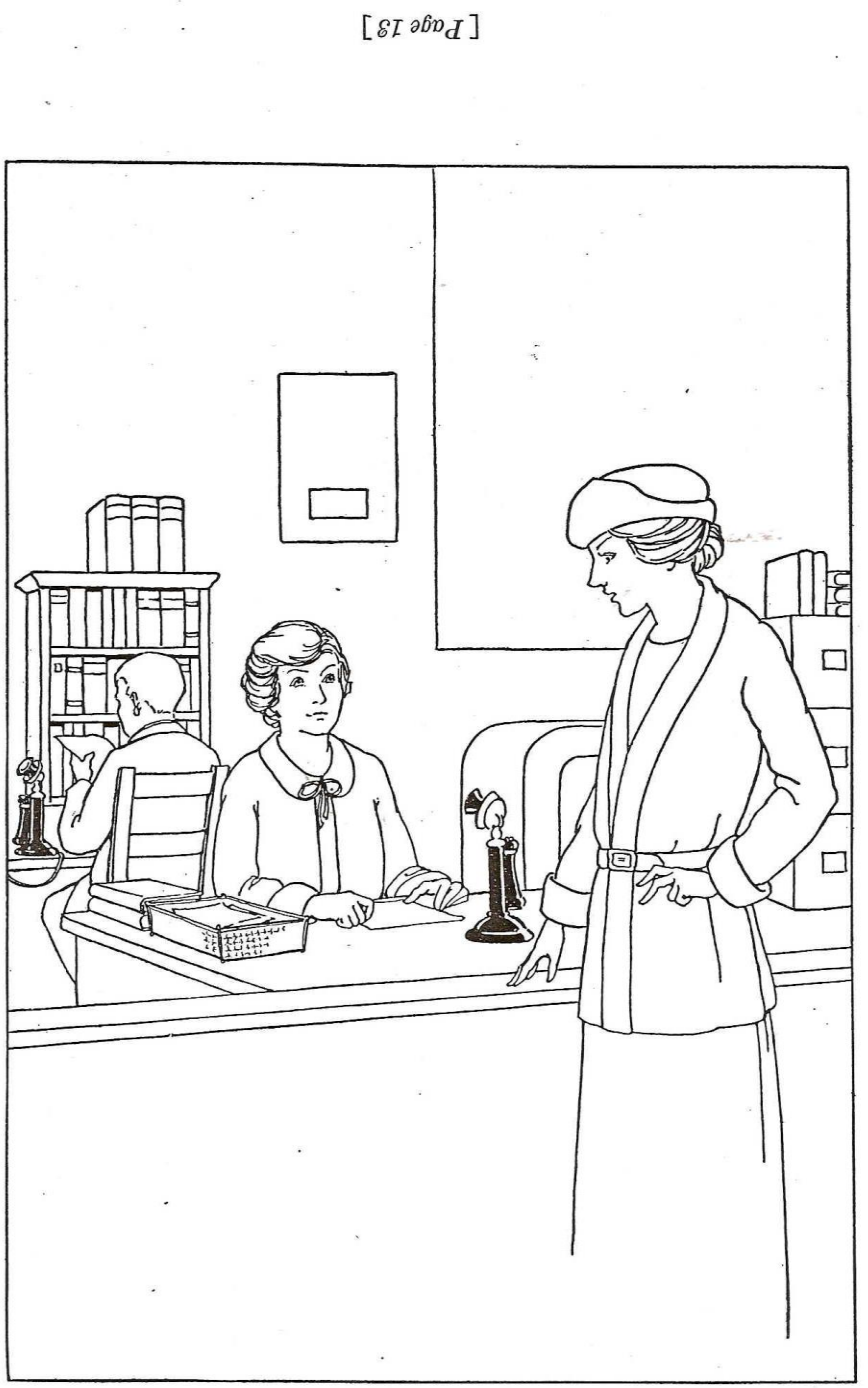
Test 6

- The full test included twenty drawings to be completed in 3 minutes
- The missing part was to be drawn by hand
- What is missing from the house (5) ? from the letter (8) ? from the small knife (10) ? or from the phonograph (18) ?
- Would a poor labourer or immigrant recognize tennis and bowling?



Cultural testing

- In 1922, the *World Book Company* associated with Lewis M. Terman offers teachers a way of measuring the intelligence of their students with this revised version of the Binet-Simon tests (right)
- Other tests conceived by Terman are offered in 1923; their goal is to identify the mentally defective who must become wards of the State



Contexts…

- Yerkes claims that the Army tests allowed the United States to win the war
- The popularity of tests thought to reveal aptitude or intelligence reaches into industry
- Ford will use various tests to direct new hires towards jobs classed as A, B ou C, from top to bottom

To recapitulate (2)

- Were intelligence or aptitude tests used in U.S. factories as early as the beginning of the 20th century?
- Were the Binet tests intended to measure the fixed intellectual capacity of their subjects?
- How did streetcars suffer when compared to private cars?
- What was the main commercial result of Ford's adoption of scientific management techniques and other productivity-boosting methods?

The Spread of Mass Production

- While Ford's mobile assembly line epitomized Fordism, mass production involved more than that single innovation
- Mass production techniques inspired many other manufacturers during the first half of the 20th century
- Even when the mobile assembly line was not adopted, the division of labour was often implemented

Henry Ford and the Mass Marketing of Automobiles

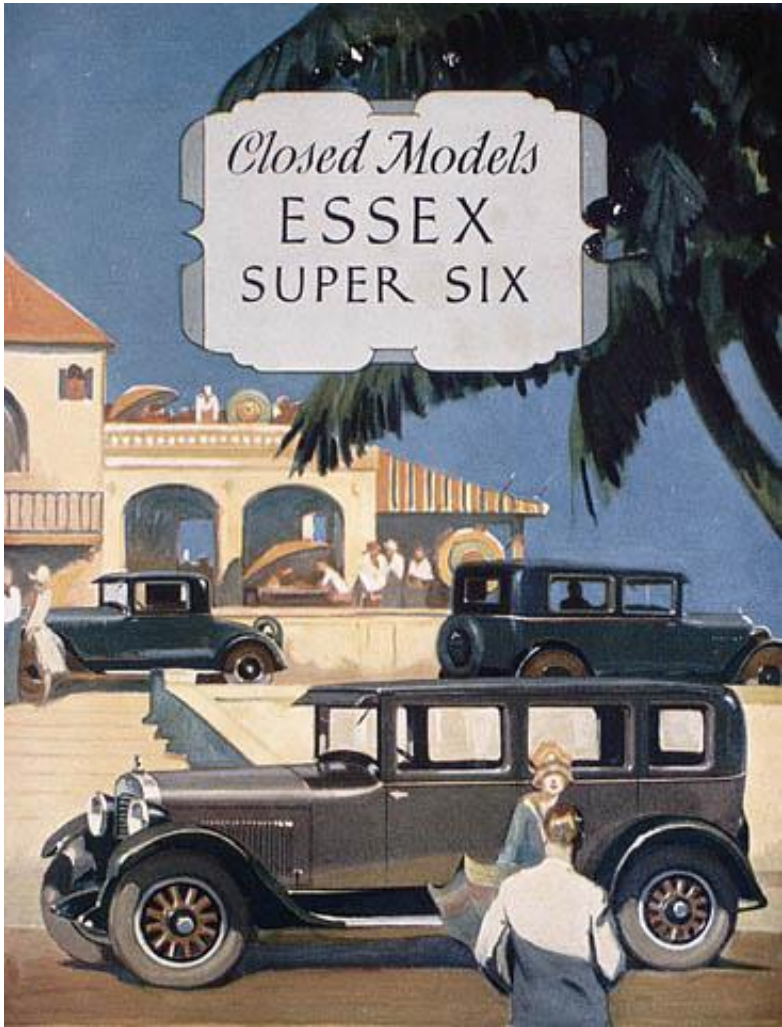
- Though electric cars lacked power and range, while steam cars were stymied by lower efficiency and infrastructure problems, gasoline-powered cars also profited from mass production
- Ford turned the car into a commodity for the masses, slashing costs and prices
- What had once been a hobby, a city-bound toy or a specialized vehicle became a product for all

The Ford Model T

(Canadian Museum of Science and Technology)

Automobiles and the Good Life

By the 1920s, cars were changing the way an ever greater number of North Americans lived, worked, and played. People built garages for their cars and pushed for road improvements. They went on outings and trips with their cars. They bought gas, commuted, and shopped.

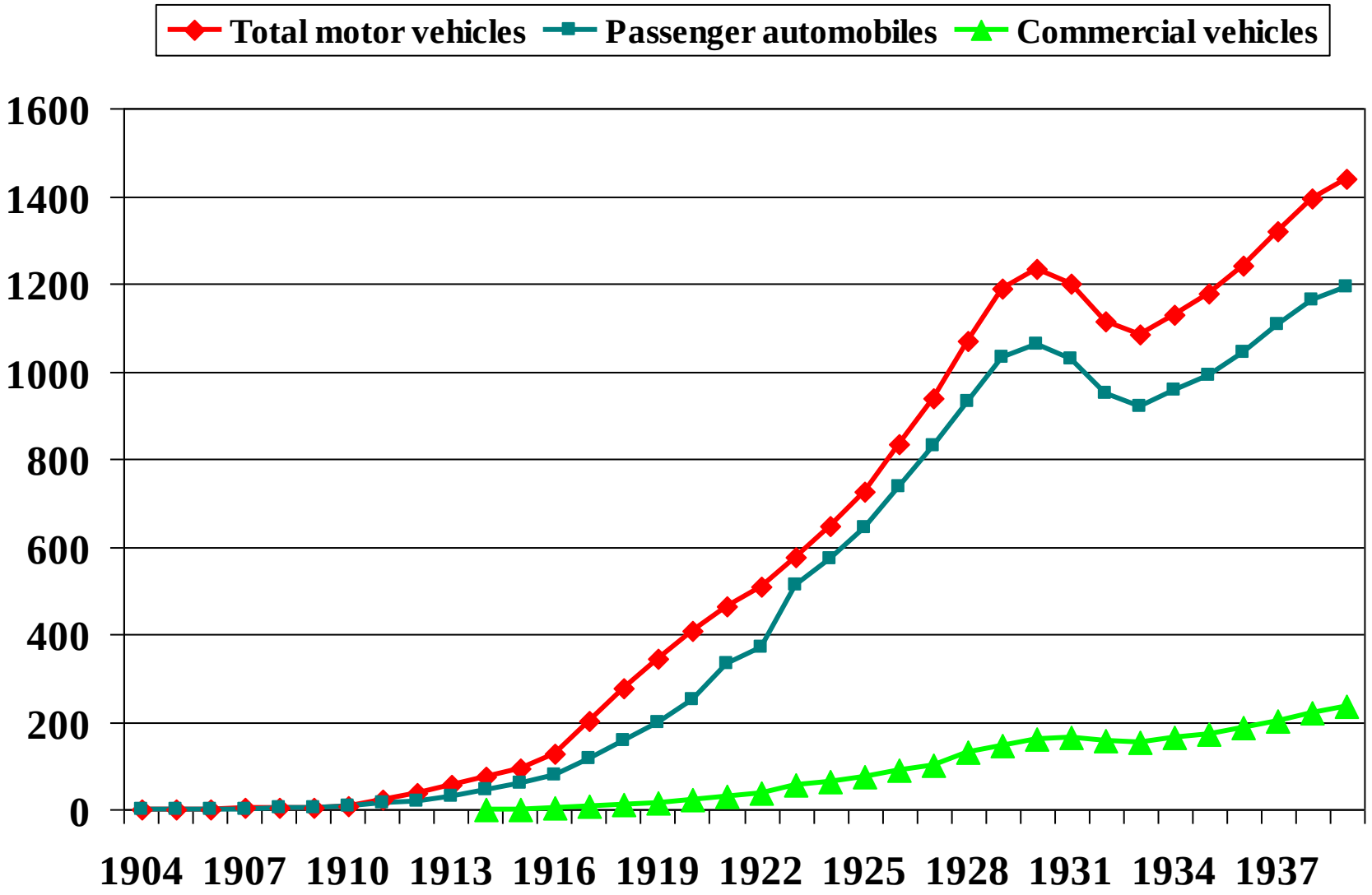


Dealer pamphlet from Tilbury (ON), Archives Canada

The Rise of the Automobile Society

- In 1904, there were about 500 motor cars in all of Canada; in 1919, there were 342,400
- In 1915, the first paved road was opened between Toronto and Hamilton
- Provincial governments quickly charged car registration fees and lobbied the federal government for funds with which to build more paved roads

Registered motor vehicles in Canada (in thousands)



A Car Show in Montreal (c. 1914)

In Detroit, the first auto show was held in December 1907 at a beer garden in Riverview Park by the local association of car dealers.

McCord Museum

Working on a car in the suburbs (1918)

Archives Canada

Montreal Commercial Garage (c. 1919)

Williams and Wilson Garage,
William Notman & Son, McCord Museum

Montreal Home Garage (c. 1931)

William Notman & Son, McCord Museum

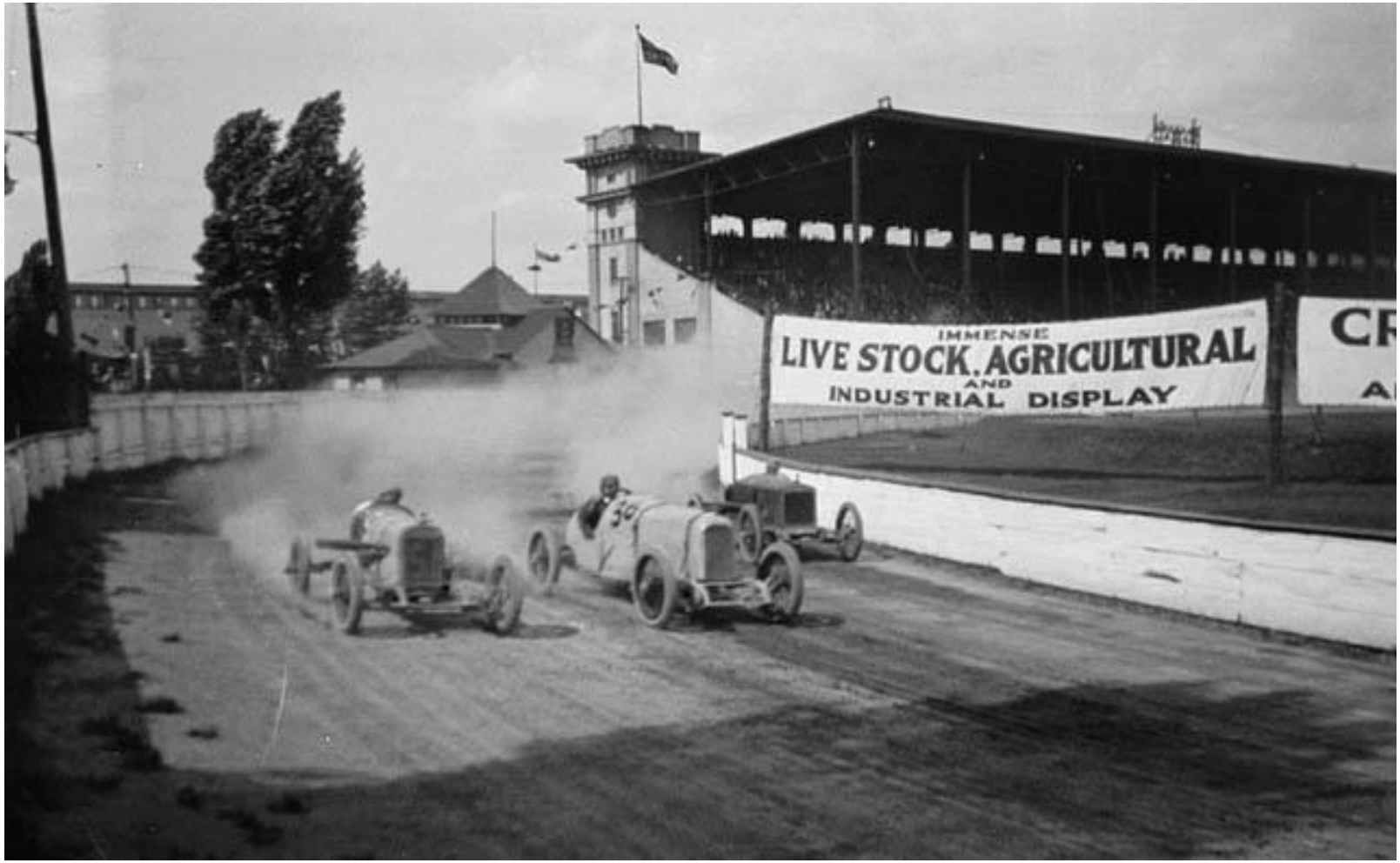
Paving streets in a Montreal suburb (c. 1925)

Sault au Récollet, McCord Museum

Montreal Gas Station (c. 1930)

Duval Motors Ltd., 3930 St. Catherine Street East

Car race at the Central Canada Exhibition (Ottawa, 1925)



Clifford M. Johnston (1896-1951), Archives Canada

A Muskoka Outing: A Model T at Moon River (ON) in 1922

T. Eaton Co. Coach Tours from Toronto to Niagara Falls (1927)

Archives Canada

Lunching on the roadside near Locust Hill (ON) in May 1927

John Boyd (1865-1941), Archives Canada

A “motor camp” on Humber Bay near Toronto (26 August 1923)

Cars were quickly adapted to the old Canadian tradition of camping out, but they encouraged all manners of travel.

John Boyd (1865-1941), Archives Canada

Another “automobile tent” in Alliston (ON) on August 6, 1923

John Boyd (1865-1941), Archives Canada

Hotel Victoria in Oak Bay, BC (*c.* 1920)

John Wood, Archives Canada

Car being pulled out of a ditch in Toronto (29 October 1922)

Erindale Avenue, John Boyd (1865-1941), Archives Canada

Another driver who may need help...

In 1923, the Canadian backcountry was not always kind to the new automobiles.

G. C. Cowper, Archives Canada

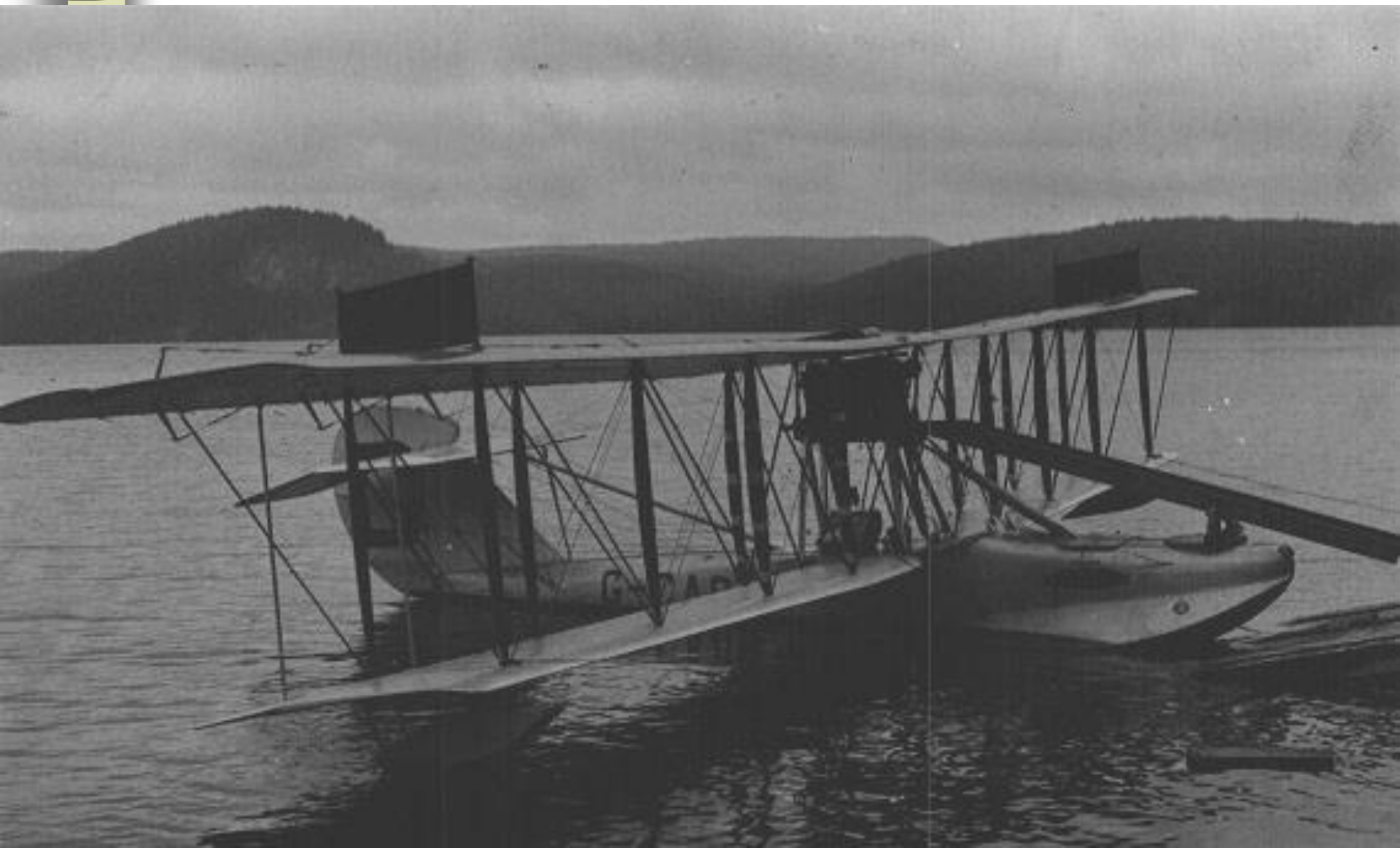
To recapitulate (3)

- How did the increasing use of private automobiles change travel in North America in the early 20th century?
- How did the increasing adoption of private automobiles change city landscapes in North America before Word War II?
- Did the car ownership rate dip in Canada after the 1929 crash?
- Was the increase of car ownership in Canada faster in the 1920s or in the 1930s?
- Identify one leisure activity predicated on cars.

Mobility under extreme conditions

- While some transportation technologies aimed to cater to everybody, others targeted more precise needs
- Used militarily during World War I, early airplanes lacked the capacity to carry large numbers of passengers or amounts of cargo
- In remote areas like the Canadian bush, they carried mail and connected isolated outposts
- Before roads were cleared on a regular basis during winter, parts of North America relied on various types of tread-equipped vehicles for transportation over snow; they were also used over muskeg
- Bombardier later developed a model for leisure

In June 1919, the Curtis HS-2L flying boat was the first commercial bush plane in Canada



The Fairchild FC-2W-2 could be used with floats or skis

The Noorduyn Norseman VI was the gold standard for early bush planes

Saskatchewan Air Ambulance (*c.* 1957)

Senior Flight Nurse Irene Sutherland,
Canadian Nurses Association, Library and Archives Canada

Early Snowmobiles in Canada

Glenbow Archives NA-3969-55

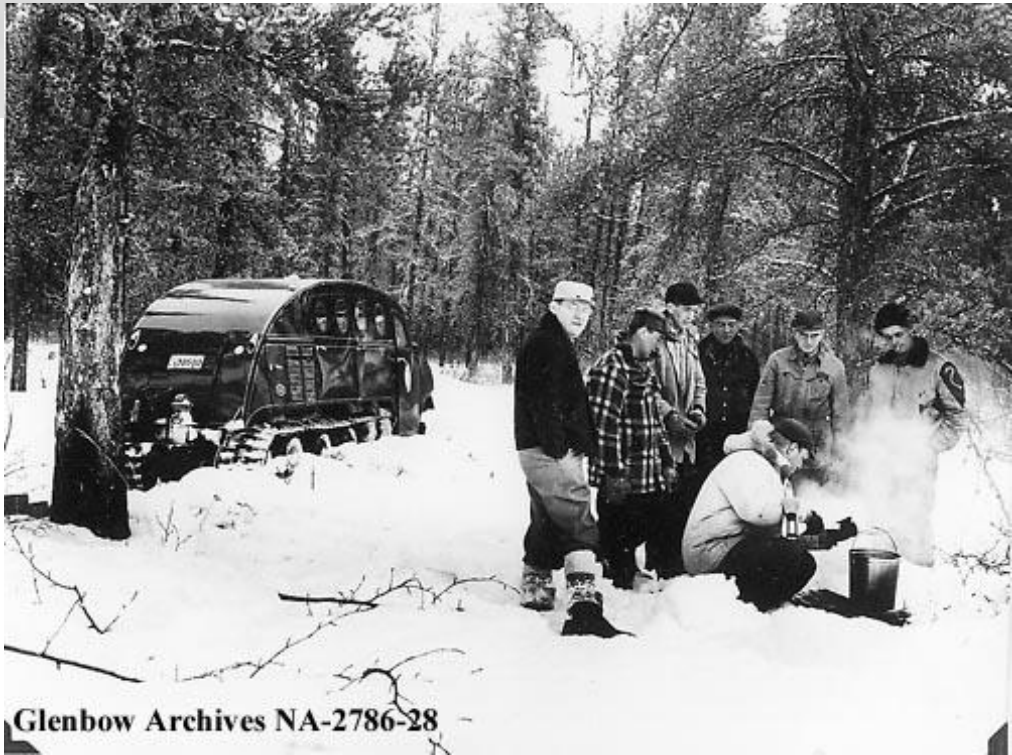
Hauling mail with an adapted Model T race car in Standard, Alberta, 1948

Glenbow Archives NA-4179-9

Hanna Area, Alberta, 1937

Early Bombardier Snowmobiles

RCMP constable with early Bombardier snowmobile at Dinner Point, Cumberland Lake, Saskatchewan, in March 1950



A campfire in the bush near Beaver River, Saskatchewan (*c*. 1950)

The Bombardier Ski-Doo for individual mobility over snow

Judge John H. Sissons on a Ski-Doo in the old Northwest Territories (*c.* 1960-65)

Bombardier brochure for 1960

To recapitulate (4)

- How was the Bombardier Ski-Doo different from a Snowmobile?
- Was Bombardier the only maker of snowmobiles?
- Why were early airplanes useful in the Canadian bush?
- In what two ways could bush planes routinely land on water?
- What was the main factor in the decreasing popularity of Bombardier Snowmobiles after World War II?

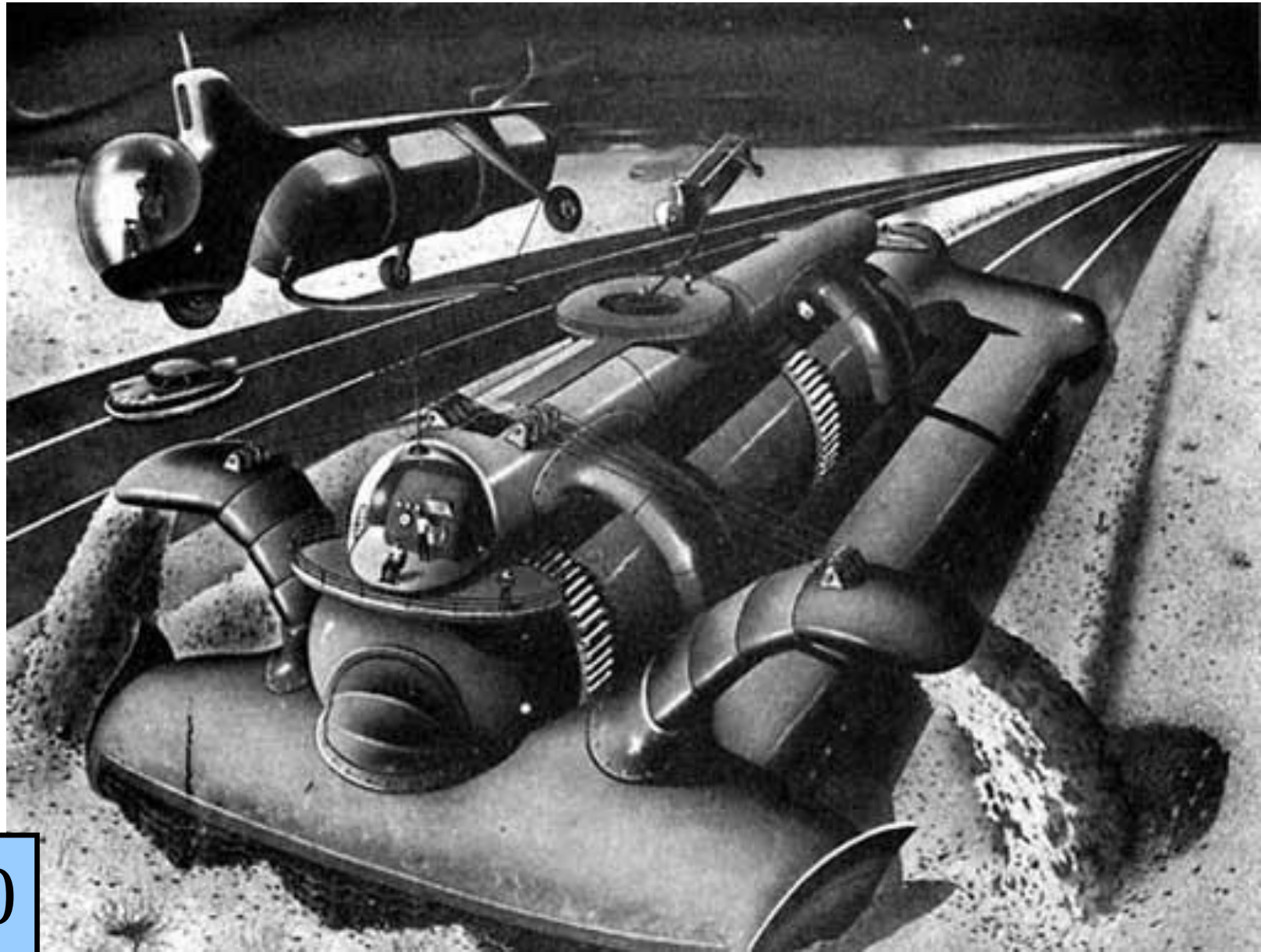
Mass Production and Mass Mobility

- Around 1900, the U.S. used approximately 3,000,000 km of rural roads, but only 220 km were paved; in 1915, even 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
- By then, the dream of paved and divided highways was already starting to take hold

Mass mobility

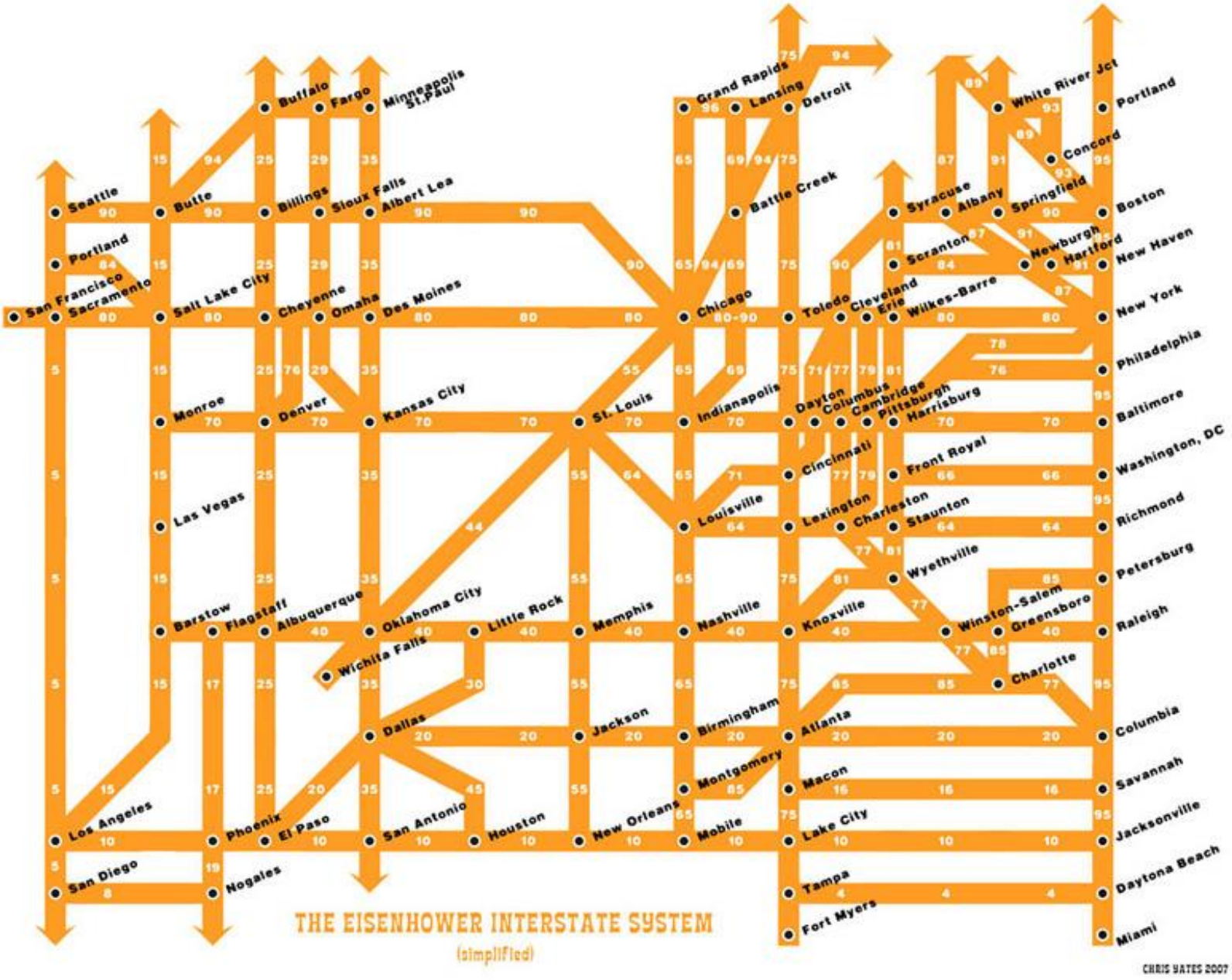
- U.S. Highways
  - the National System of Interstate and Defence Highways
- Canadian Highways
  - the first “Canadian Highway”
  - paving new roads
  - the first “divided highway” in Canada
  - the heyday of motels and drive-ins
  - unfinished highways

Interstate Highways: The Dream



c. 1940

Interstate Highways: The Plan



Interstate Highways: The reality…

- The law approved in 1956 by president Eisenhower mandated a “National System of Interstate and Defense Highways” to be built by the federal and state governments
- The federal Bureau of Public Roads disbursed **90%** of the costs, but the individual states designed the highways
- The network was to be completed in 1972 (later 1975) and span 65,000 km

The “Canadian Highway” on Vancouver Island (1912)

The new motor cars broke down the old macadam roads because they were somewhat heavier and certainly faster. To improve roads, the forward-looking Ontario Good Roads Association was founded in 1894. In 1911, the New Westminster, B.C., Canadian Highway Association started promoting the idea of a “Canadian Highway” from Alberni to Halifax. The cause was then upheld by the Canadian Automobile Federation (1913), later to be known as the C.A.A.

The first post of the "Canadian Highway" (Alberni, BC, 4 May 1912)

Library and Archives Canada

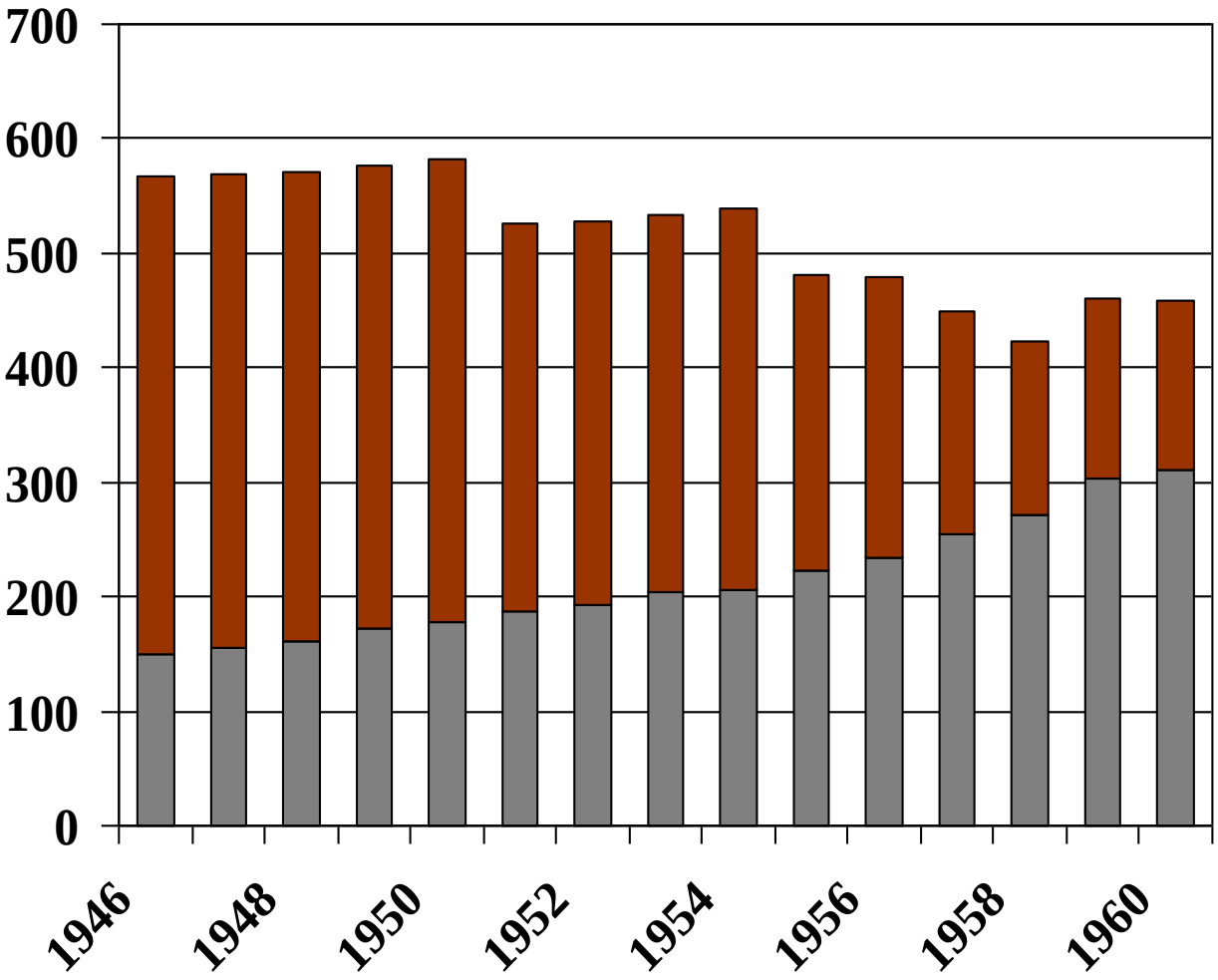
Farmers fleeing the drought in Saskatchewan on a “highway” near Battleford (1930)

Nobody drove a car across Canada on Canadian roads until 1946 when R. A. Macfarlane and Kenneth MacGillivray took their Chevrolet from Louisbourg, N.S., to Victoria, B.C., in nine days.

Department of the Interior, Library and Archives Canada

Roads and streets in Canada
(in thousands of miles)

Surfaced roads include concrete roads, asphalt-paved roads, and gravel roads.



Part of the decrease in earth roads results from the exclusion of private mining or logging roads and of unbuilt road allowances, both previously included.

Adding to the Calgary-Banff Highway in March 1934

(An Army Unemployment Relief Project)

The Queen Elizabeth Way near St. Catharines (ON) in 1950

It was originally opened in 1939 as the first four-lane divided highway in Canada, and later improved. It ran from Toronto to Niagara Falls, at first, and later to Fort Erie. But Canada still does not have a continuous transcanadian divided highway.

The Heyday of Motels and Drive-Ins

By the late forties in Canada and the United States, motels replaced the older types of accommodation. To attract attention, they often combined garish colour schemes and neon, lots of neon...

1947!

This Montreal-area motel was founded in 1947 and still retains some of the characteristic furniture and decorative touches of the 1950s and 1960s.

The Age of the Drive-In

Near Saint-Eustache, this "*Ciné Parc*" (drive-in) also retains some of the garish touches of an era that ran out of gas after the 1973 oil crisis.

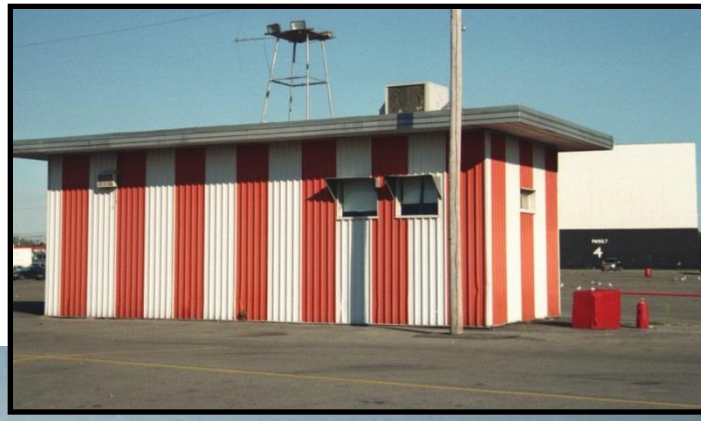
Going to the movies—in a car

- The first drive-in is credited to Richard Hollingshead in Camden (New Jersey) in 1933
- In the U.S., the number of drive-ins grew after WWII and may have peaked in 1958, with about 4,000 operations in use
- Drive-ins declined due to: the late-60s switch to daylight saving time, pushing back the start of showings; the resulting switch to B movies instead of first-run features for the whole family; the spread of the VCR; and urban sprawl, which pushed up land values in the suburbs

Going to the Drive-In…

←the screen's back

the projection booth →



Unfinished Highways in Canada

In Quebec City, a pair of highway ramps led, for over 30 years, right into a wall.

Tunnel to Nowhere…

The highway was designed to pass through a tunnel under some of Quebec City's most important buildings (the Citadel, the National Assembly), but the tunnel was never completed.

The Dufferin-Montmorency Hwy

Demolishing the Unbuilt

The highway had ravaged Quebec City's Chinatown when it was built. The useless ramps were demolished in 2007.

Gaining A New Interchange

The ramps leading to the aborted tunnels have been replaced by new off-ramps leading into the surrounding neighbourhood; another off-ramp has been demolished.

The Unknown Fate of the Tunnels

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The tunnels were never completed, but a sizable cavity was created beyond the concrete barriers. Its fate is still undetermined.

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