STS 007 Class Notes class 17

Second Industrial Revolution

Pivot point: 1850 – bring together European and American history – will go to MIT and US on Thursday

Crystal Palace 1851 - middle class (vote, after 1831) – Corn Laws repealed 1846 – but enormous worry about working class – Irish famine-

1848 revolutions "Spring of nations"

France, Germany, Italy, Denmark (Russia and A-H)

Democracy, liberalism, nationalism, socialism

US in 1850

To learn more about the US in 1850, see: The Compromise of 1850

Individuals vs. collective in victory:

Tolstoy reading – about War and Peace, Napoleonic victories (and also retreat from Moscow) – the spectacle of millions of men in motion – "revolution" – causality: looking for laws – "change the subject" - Two fallacies: beginnings and endings, individuals –

Tufte's famous representation

How does it change how you think about "technology in history"?

Schivelbusch The Culture of Defeat

How you think about "technology in history" – three examples: Civil War, France, Germany – Dower's Embracing Defeat (we will read Hiroshima)– "losers in battle, winners in spirit" – savage winners, fear of being overrun by barbarians – borrowing technology and organization in service of higher cause

Theme of "unconditional surrender" – Sherman and Grant

South affirming white supremacy – slavery a fatal misadventure (69) – now there will be a New South – "the Cold War of Reconstruction" (73) – go back to status quo under different arrangements – but military occupation, Northern rules – led to repression – ten years – black codes – things began to settle down – economic colony (84)- low per capita income, a third to national average

Much more “civilized” to Europeans than Yankees – read p. 46 – a second war for independence

Capitalist but with another knightly spirit – technological-economic modernity and feudal-romantic spirit (54)

Choice of two kinds of exploitation/production (energy)

[“For Obama,” Mr. Remnick concludes, “the black freedom struggle defines not just the African-American experience, but the American experience itself” — the story, as Mr. Obama has observed, that “we as African-Americans are American, and that our story is America’s story, and that by perfecting our rights we perfect the Union.”]

Ends with… On Falling” – Soviet defeat in Cold War – third stage of global cold war in 20th c., only economic not military – “skipped over the actual process of destruction on the battlefield” – “globalization” the new buzz word –

Pub. 2001 - American defeat, unemployed as vanquished – 9/11 as merchants’ tower – “to fall” – 1975 evacuation photo – shadowy adversary but you go after Afghanistan, exorcising Vietnam? (294)

Discussion of The Communist Manifesto – the different sections

Written late 1847 (secret) trans into English 1850

(background: Marx connecting with Engels, in exile in London)

To learn more about the Communist League, see: The Communist League.

Christian’s comments: political movement, historical analysis – one of century’s two great excavators (the other being Freud)

Remember earlier reference to “prehistory” – footnote about recorded and non-recorded social organization (how he defines history) – “primeval communities”

Most important: what is generating new technologies, what their implications are

Class struggles – simplified

“revolutionary element” was new world, new exchanges” : disc of new world, modern industry, world market (is “technology” mentioned?)

Series of revolutions in production and exchange - read

Substructure for political changes: development of the bourgeoisie – “the executive of the modern state….” (today?)

Cultural results – “disenchantment” idea that S. uses – constant revolution has been introduced – second, third, many industrial revolutions

Also globalization is inherent – business disrupts nations - cheapness

New wants

Intellectual results: world literature

Urbanization: idiocy of rural life

centralization

Tone? “more massive and more colossal productive forces…”

Irony, contradiction of capitalism: its own gravedigger, just as feudal society was (European-centric)

Commercial crises: too much production, too much civilization, destabilize bourgeois society which cannot assimilate the wealth it has created (contrast with Malthus)

Creation of wage-earning class – mass of workers, gathered together, slaves to machine

Development of class consciousness - technological unemployment – things are sped up – unions, some rules (10 hours bill) - “special and essential product” – what’s inevitable

2nd section on essential claims – working men have no country – abolition of private property

Criticizes other types of socialism, including the neo-feudalistic

Second Industrial Revolution - Mokyr: 1870 – 1914 – last third of century

Slide

A jumble of stuff – as I say in Retooling, steel, chemicals, autos, cinema, electricity, turbines…

The cautionary note: Edgerton on “technologies in use” (Haiti: charcoal, bicycle, corrugated aluminum) – above all

Making same mistake as Tolstoy warns about: small units not integrals; details not “laws of change”

Slide

1. But continued realization that constant revolution was now the norm
2. Method: laid way for more revolutions/waves to come – changed relation between knowledge and power

Mokyr: much more of a scientific base: chemistry, metallurgy, thermodynamics

3. Part are grids: electrical; subways, automobiles/highways, trolleys (Friday), telephone

Move from things to systems – stress that they are envirotechnical systems

Not sweeping away the old as reinforcing and extending – layering (global IR: Roe’s class)

4. More dispersed, beyond Britain - esp. Germany– also Russia, Sweden, Netherlands, North American; beyond West in general : India, Japan, Africa – Hobsbawm: the age of empire, both classic imperialism and more general type) – Lenin’s theory
   – intl trade tripled 1880-1913 – state rivalry – but Britain dominant in shipping, finance

Continuing major themes of IR

SLIDE

Railway system – reinforced – as many miles of track laid 1880-1913 as in original railways age 1850-1880 – many European countries doubled their network in these years – intercontinental line in US - Russian railways

100,000 locomotives, of 200-450 HP, two and three quarter million carriages – huge public works project – by 1880 2 billion people a year traveled on them, mainly Europe and North America

Diesel engine in 1907, electrical locomotives

More locally: subways, trolleys, streetcar suburbs (Frankfurt and Glasgow, 1884)

SLIDES of Brooklyn Bridge

Building connective systems with new materials: vehicles and systems/roadways – all systems are envirotechnical

To learn more about the Brooklyn Bridge, see: The Brooklyn Bridge.

Carried trains until 1944, streetcars until 1950

Began 1870, drawings earlier

Steam power at sea

Steel used for ships after 1870 –In 1882 ca. 22,000 steamships in the world, still less tonnage than sailing ships – began to change dramatically in favor of steam in 1880s

steam turbines used, esp after 1900 – freight costs dropped

Slides of 1887 Jubilee Atlas (Around the World in 80 Days, 1864) First age of globalization (Suzanne Berger) - "tentacles of progress" – POSH – Suez, Panama imagined

Effect on world agriculture - – farmworkers and farmers still made up close to half the population (except in GB), up to 90% in many countries

Steamship and railway transport: grain markets – US and Canada after 1900: drop was ca. 52 million bushels a year in 1890s, 200 millions in 1910-13 – Argentina also (Italian laborers helped harvest)

Grain trade: Interactions of steamboats, railways, and food distribution

Cronon on grain silos, marketing (p. 111)

To learn more about grain elevators, see: Grain Elevators

In Europe, a spectacular decline in agr profits – great depression that began in 1870s – in 1894 the price of wheat in GB was a little more than a third of what it had been in 1867 Technologies of preservation - Mechanical refrigeration: first frozen beef plant set up in Sydney in 1861 – chilling (just below freezing) used between US and GB before 1870 – in later 1870s, deep freezing (14 degrees F) came in, first from Argentina to France – by 1880s beef, mutton, and lamb from South American were being served in Europe

Canning in American civil war – milk powder (Borden) in 1850s –

GB started importing a tremendous amount of food, let her own food production decline a lot – by 1905-9 imported 56% of cereals, 76% cheese, 68% eggs

Capitalism has to be global (Communist Manifesto) – even Conservatives in GB willing to give up agriculture – "What capitalism exists to make, after all, is not any particular selection of products but money." (Hobsbawm, age of empire, 40) (but land is not like any other commodity)

Threshers, reapers – slow mechanization however – draft animals kept being used – threshing machine was most successful, attached t o steam engines – internal combustion engine was a real breakthrough (tractors and combines introduced just before WWI)

Use of nitrates, potassium and phosphates as fertilizers – also guano

Productivity keeps rising, but energy intensity of the whole system: Michael Pollan, Omnivore's Dilemma, 2007

Also mass production:

Textiles:

Power looms continued to be used, mechanized only in 1890s

lock stitch patented in 1846 by Elias Howe – Singer added foot treadle – ca. 5 times faster than hand sewing – ca 2200 sold in 1853, 500,000 in 1870 - also shoes and carpets –

(Combing of wool which had long defied mechanization improved by a "nip machine" in 1850s, reviving fortunes of Yorkshire worsted industries)

Development of Southern US textile industry 1890s – continuous process of outsourcing, further and further (black labor, terrible conditions)

"American system" of production – mechanized mass production and interchangeable parts not the same thing – mass production didn't need the latter (firearms, clocks, pumps, locks, reapers, typewriters, sewing machines, engines, bicycles)

Slides

Metallurgy: iron to steel : Bessemer 1856, converter, using carbon impurities in cast iron to make fuel, to get desired mix of iron and carbon – also Siemens Martin open hearth process, high temps, mixing cast iron with wrought iron, adding limestone to combine with harmful phosphorus – blast furnaces got larger and hotter (80 feet temps of 1000 deg F)

To learn about Steel & Iron, see: Profile: Steel & Iron - Wheeling Jesuit University

would they give up industry too, if it clashed with financial goals?

Transition to petroleum began not so much as industrial energy source but domestic lighting - Schivebusch

Hard rock drilling, Pa in 1859, Caspian sea 1870s, Texas 1901

First used for lighting (kerosene) – main market for first 50 years (replaced by cheap electric power)

Then fuel-oil burning furnaces for home and industrial heating – half of industry by 1909

Then a whole new market began to arise, with automobile – internal combustion engine as competitor to steam engine – advances in thermodynamic theory, ideal cycles – four –cycle

engine (Otto, later Daimler): intake, compression, combustion and expansion, exhaust (Carnot ideal cycle) – had to have right mix of air and liquid – Daimler used petroleum instead of coal gas for a fuel - could be turned on and off quickly

Bicycles led the way with pneumatic tires, road systems

autos began to appear in 1890s – made airplane possible (1903) – Wright bros as bicycle makers, understanding role of pilot

by 1914 Ford sold a quarter of a million model Ts a year

SLIDE of global oil consumption

Deriviatives: secondary markets: fertilizers, plastics, synthetic fibers, pharmaceuticals, petrochemicals

Coal and oil as fuel– turning prehistoric stored solar energy into heat – in steel mills too – Rolf Peter Sieferle, The Subterranean Forest: Energy Systems and the IR

next class, more on this, including: by 1930 the primary refined oil product – catalytic cracking

Electricity – knowledge of properties and behavior remained meager (lightning rod was one practical use, after two centuries of experimentation with frictional machines) – Volta's pile (1800) (electrochemical battery): could finally discover properties of currents – Faraday's discovery of electromagnetic induction 1831 – could then use mechanical means to generate electric current – beginning of generators (and motors) – didn't have to use shafting, pulleys, belts, gear trains as you did to distribute water power: you could use a generator and distribute the power to multiple motors – took 50 years to get from Faraday's discovery to electric power generation

SLIDE of dynamo, Pearl Street station, lower Manhattan

Electricity used for arc lamp by Davy 1808, used in lighthouses – arc lamp became practical in late 1870s, used for public places, replacing gas light

Schivelbusch on Disenchanted night – cultural effects – things never before possible –How electric light systems were modelled on gaslight ones

Edison's lab in Menlo Park 1876 - Edison lightbub in early 1880s, Edison's system in NY – by 1900 a lightbulb cost one fifth of what it had in 1880, and was twice as efficient

Hydroelectric projects – replacing canals as main type of industrialized rivers – "white coal"

Utopian visions – Schivelbusch on agriculture, medicine

Bellamy's Looking Backward 1888, set in 2000 – nationalist reform movement – no fires and chimneys, broadcast telephone, central services, one big dept store, industrial ary – Equality 1897 – Mumford on "neotechnic"

networks of power: from things to systems Hughes slides

Penn Power and Light Co – Load duration and station loading 1936 (Hughes p. 438) "Achieving an economic mix of power stations to meet varying demands"

Configuration of evolving systems (Hughes 3). Berlin distribution system, upper left 1885, inner city; centralized urban system, Chicago 1906, right; regional, from Dutch border to Switzerland, 1930

Statistics of evolving systems in 3 countries. Electricity generated by public utilities in Germany, 1880-1940; by utilities in US, 1882-1921 (upper right); in UK from 1895-1913 (lower left) and from 1920-1938 (lower right)

Communications –Christian on communication networks

Mechanized printing press – British newspaper sold a million copies in 1890s, a French one in 1900 – rotary press, typesetting, typecasting, linotype – use of woodpulp perfected

Postal system: penny post – average no of letters sent in GB in early 1800s was two a year; by first part of 1880s, 42 a year – millions of copies of newspapers and journals

Typewriter in 1870s (lots of people working on this)

Telegraph: Morse, grew up with railways; first submarine cable laid under Channel 1851 – but at first most submarine cables were lost (17,700 miles laid before 1861, only 4800 operational that year) –William Thomson/Lord Kelvin worked on this (galvanometer, short reverse pulses after main one to sharpen the signal)

Telephone (1876)

Cinema, photography, phonograph, and radio all worked on in 1890s – radio implicit in work of Maxwell (1865); he suggested existence of EM waves, which were demonstrated to exist by Hertz in 1888 – Lodge and Marconi developed wireless telegraphy in 1890s; sound waves first transmitted 1906

Schivelbusch on travel experience, world experience – also cutting up the land – social habits change - time and space are changed (daylight savings time)

Excursions, also permanent change of home: mobility

Culture of migration – 1880s saw highest ever rates of overseas migration for "the countries of the old emigration" (except Ireland after the Great Famine) – and start of mass emigration from Italy, Spain, A-H, Russia, Balkans (Hobsbawm) – safety valve

New kind of theatre experience

A history of bourgeois perception – the Gutenberg parenthesis

Worlds fairs
Eiffel tower

Consumer culture: Democratization of luxury: credit

Management

Business models and organizations: Chandler, The Visible Hand – vs quartermaster article – time again (Mumford again)

Much more office work, tertiary sector

Economies of throughput and scale

Same with Hughes and power industry (load factor)

Large corps (Carnegie Steel, Gen Electric, Dupont, Ford) – but most businesses still "flexible specialized" production

Blocs and fluid – no longer "wealth of nations" (back to Communist Manifesto)

The rich stayed rich – in 1870 four main industrial states produced 80% of world's total manu output; in 1913, 72%, but total output was five times as great

But it's not about gadgets - sharp decline in mortality rates – life expectancy (in GB from 40 to 50 years) – decline in infant mortality by about half – Pasteur, Koch, infections, insects, cooking water

Three elements of progress: productivity/wealth creation, disease eradication, life expectancy

Imperialism: age of empire (Hobsbawm) –

US in Samoa – a "footnote to history"

Heart of Darkness; The Ebb-Tide

but more than this

"the end of the world" –maps

Next class reading:

Christian, questions relate to Manifesto, also to Schivelbusch readings

Retooling – my effort to understand info rev, to bring it back to MIT (next class: MIT history, also second IR seen through lens of MIT student/professor) – start p. 19

Chemicals: organic chemistry, Liebig in 1840s - Englishman Perkin was trying to produce artificial auinine; accidentally discovered in 1856 aniline purple, or mauveine, replacing natural dye mauve – magenta followed – Germans competed, developed hegemony in chemical discovery – indigo, sulphuric acid, soda, dynamite – fertilizer – Haber process to make ammonia, then ammonia could be converted into nitric acid ca. 1908 – nitrates (hydrogen and nitrogen) used for fertilizers and explosives in WW I though Chilean supply was cut off

Rubber (vulcanization), celluloid (first synthetic plastic 1869), Bakelite (1907)

(new university model)

Disinfectants and antiseptics, aspirin 1899

remember these are fabrics not finished clothes, "ready to wear" – another reverse salient (Grandma's sewing room) – heating system installed

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