

Slides 2, 3, 4

my grandfather Warren K. Lewis, who entered MIT in 1901 and became a founder of chemical engineering – catalytic cracking, Manhattan Project, undergraduate education at MIT

will describe his world and that of chemical engineering in early years of 20th c. and then look at chemical engineering at MIT in the early 21st c.-
you are as well acquainted with daily life now (and eng.) as I am so I invite you to join in making comparisons and contrasts

Slide 5 - farmhouse

Born 1882 on Spring Garden Farm, Laurel Delaware, bought by his seafaring grandfather in 1813, 400 acres, prosperous

His grandfather was one of 21 children; for every one that survived (7), two died – 3 wives

His father named Henry Clay after “the Great Emancipator,” saw troops returning from Harpers Ferry in 1860, Republican, abolitionist yet family owned slaves (let them buy their freedom)

Why I mention these things: history of technology is part of much larger human history longer cycles, deeper changes more important than anything we typically think of as “tech. innovation”

e.g. longevity, mortality esp. of women and children

e.g. impact of war – more killed in Civil War than all other US wars combined

e.g. great moral and social issue of slavery

all related to “technology” (medicine, weapons, productivity of labor) but not easily reducible to material change – deep historical question is relation between material and other types of change (social, intellectual, cultural)

Slide 6 – Kranzberg’s laws (who Mel was)

Slide 7 – contextual history of technology

Slide 8 - map

another big change: migration from country to city, reduction of farm population in US, huge gains in productivity, extension of market reach - railroad to Laurel in 1859

in 1897, age 15, WKL came to Newton Mass from Laurel

Goal: to be a better farmer-get education up north, had finished local school

Slide 9 – Hunnewell Ave.

boarding in Newton with Kendrick family, looked after by cousin Mary who taught English at Lasell, going to high school

Diary from winter of 1898 –little details that remind us of what is now called the Second Industrial Revolution – most concentrated period of changes in daily life, made everyday life far more comfortable and interesting than ever before

Post in 1997: The late 19th c was the greatest period of tech'l change in terms of things that affected huge numbers of people's lives in basic ways—much more so than today.”

Distinctive contributions were distribution of cheap and flexible energy in the form of electricity, construction of layer of grids of communication and transportation (subways, automobiles, telephone, radio), and democratization of luxury through proliferation of cheaper and more varied consumer goods

Thursday Jan 12

After school I went up to Lasell and read Cicero with Cousin Mary, and then she gave me a supper of canned chicken, cocoa, bread, butter, crackers and peanut butter. I had a fine time. (globalized systems already, industrialized food)

home – “four factories were going up in Laurel and vicinity for canning, he is going to put out 10 acres of tomatoes, he has only four cows now” (those railroads)

Shopping not making – more food

Today as I was walking home from school, Cousin Mary, in the electrics, saw me, got out and walked home with me. Then we went into Boston. I got my coat; she bought two tin basins, a pie pan, a strainer and a dozen knives and forks. She carried in a mug strainer belonging to a coffee pot, to fit the strainer she bought to it. –

Large technological systems, street car suburbs – progress defined as their extension – and as improvements in material comfort through low-cost production for mass use –

Feb.24 “Yesterday afternoon I went up to Auburndale. It seems Cousin Mary telephoned me not to go. I forgot it. She was down in Newtonville waiting for me and we just missed. She went to Newton. But we could hear from each other now, by telephone. I started for Newton. She got on the train there and we went into Boston and saw the new pictures by ? in the Art Museum. They were very good—especially those of Joan of Arc.

Transportation: I went down town in the evening and rode. I asked a man passing for a ride and he consented; it was the first time I've ridden on or behind a horse since last Sept., and I a farmer's boy.

Slides 10, 11, 12, 13 as easy to get in then as now
Subways being built, trolleys, railroads

information age

Postal system -Regularly exchanged letters from home

A lot of reading – not just Cicero and Shakespeare for school but Treasure Island for fun– go to library frequently, have a card

Magazines – Advocates, also one from home – articles on South Africa

Church, glee club performances at Lasell, Fremont Temple lecture, play about the pied piper with little boys as rats, performance of As you like it

Trip to Museum of Fine Arts – drawing class in school, discussing modern illustrators like Pyle – starts looking for their works everywhere – Cousin Mary gives him many pictures by them – read lives of the illustrators - doing mechanical drawing

This too is an information age, full of it, not esp. privileged in terms of money (schoolteacher, farm kid paying room and board) – very different culture but that is the key difference not lack of info.

much more adult, partly his circumstances but the general weight of bourgeois culture (art, libraries, lectures, church) and absence of “youth culture,” not a market - is this progress or not? Need for a more subtle vocabulary

political information

, listening to a senator lecture in the assembly hall about Roger Sherman and the D of I (“old but not worn”)

Jan. 20 Goes into Boston to hear a lecture on Imperialism by Dr. Lyman Abbott. “The lecture was a fine one in favor of staying to help them learn to govern themselves.” Goes to another lecture a week later, same topic, another speaker: “He made some good points but as Cousin Mary said some bad ones. He attacked Dr. Abbott, saying he made some misstatements concerning the arguments on Californian annexation, and made McKinley out as having imperial power....Cousin Mary is on his side but I can’t say I am.”

Tuesday Feb. 7:

“We received our first news yesterday of the battle of Mannilla on Sunday.” News reports about dead and wounded in Philippines. “The gunboats did fearful execution.”

Washington’s birthday: church bells range out morning noon and night, flags out, visits, would have a grange celebration at home “These are the signs to me that it is the anniversary of the birth of the greatest **American** ever born”

Gary Downey: “engineering as a profession in a given country always seemed to take off at the point of nationhood. “ – sense of contributing to general welfare and national strength – not state but community

Reminders about state of medicine – Mr. Kendrick old and frail, they pick him up when he falls, toothaches, not feeling well, getting arsenic pills for Mrs.Kendrick...
heating, shoveling, Spartan
Snowstorms, keeping warm, taking out ashes, shoveling all day
Not so different!

In late Feb. WKL asks two teachers “about what they thought would be best for me to do about going to college. They will think it over more but the former advised either Amherst Agricultural or as even better Tech.” one of them mentioned Cornell

Typical for engineers then to come from farms and small towns

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High school friend went to Boston Tech (Kenway household: married the daughter)

Slide 16

MIT in 1901, when he entered
Word “technology” still unusual

Entered to study mechanical engineering - still dominant along with civil, the oldest organized engineering organization, and military engineering, oldest of all

But two new types of engineering emerging, electrical and chemical

Engineering not a stable profession – meaning of this term has changed dramatically over the centuries

In both cases great expansion of knowledge base mainly from scientific research

industrial processes involving chemistry go back to antiquity: brewing, bleaches and organic dyes, ceramics, sugar, glass-making, soap-making, tanning, paper-making – largely batch processes, small-scale, divorced from any scientific knowledge

great expansion of chemical knowledge base in 19th c. was crucial in development of large-scale chemical industries – classic case, 150 years ago, William Perkin’s discovery of mauve, made from coal tar, followed by discovery of structure of benzene molecule (Kekule 1865) synthetic organic chemistry opened up possibility of many more dyestuffs

fine chemists from German universities, but looked at problems from point of view of laboratory worker, thinking of themselves as industrial or applied chemists specializing in a specific industry; left details of equipment construction to mechanical engineers, who had little or no understanding of the chemical processes –in WKL’s words “There was an

iron curtain between chemistry and engineering.” (Evolution, 1) – had to do with social class

WKL entered MIT just at the moment of the emergence of chemical engineering as a distinctive professional identity around 1890s through early 1920s (7000 chem eng students nationally, definitive text Principles of ChemEng 1923 by Walker, Lewis, McAdams)

Slide 17 – industrial chemistry lab 1893 MIT

not an applied chemist but an engineer, not a specialist in a particular industry but “a member of a great professional group united by the possession of common skills and activities” (WKL, Evolution, 1) –

“The stimulus of these concepts made work in chem. Eng at the Institute from 1902 to the outbreak of WWI an inspiration for both staff and student which it is impossible to describe.”

But also a time of tensions

Engineering always working on two fronts – science and business

Always in danger of losing turf battles to either or both

MIT story is especially interesting because two strong individuals represented these two pulls

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Arthur Amos Noyes, trained in Germany, physical chemist, began teaching one of the earliest and strongest p chem. Programs in the country – this became part of the chemical engineering curriculum in 1902: “There was to be no iron curtain between chemistry and engineering at MIT” (Evolution, 6)

Eng. science not a post WW II invention – much earlier – solid scientific basis, but not physics as with mech eng.

But Noyes as a chemist continued to see chemical eng. from the perspective of the research lab

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Industrial connections stressed by William H. Walker, Penn State and Gottingen, was teaching analytical chemistry, at MIT since 1890 – partner of AD Little in consulting practice to apply physics and chemistry to industry – returned to MIT, entrusted with Course X in 1903, part of chemistry dept.

Walker in 1934: **Slide 20**

But not a matter of giving industry what it wants: instead, looking ahead to problems not even imagined at the time

What an industry needed was not a man who had been taught what that industry already knew, but rather a man who was trained to do what the industry had not been able to do...the ideal man for the industries was one who had been given a sound knowledge of chemistry and physics, and then as a part of the curriculum had been given systematic experience in the application of this knowledge to the solution of industrial problems; that he should not be a specialist but a solver of problems—any kind of problem that industry might present. This idea met opposition both from established courses of chemical instruction and from industry.

“To prove the soundness of this idea I returned to MIT in 1903 and after a hot fight with both the chemical and the engineering faculties I reconstructed Course X as a general educational course without options.”

Cut out foundry practice, introduced and required p chem., strengthened organic and advanced inorganic chemistry – to get students to understand fundamental mechanisms of what was going on

WKL (evo. 6) – fall of 1904, quiz in p chem. Under Walker: “If pure ice and pure salt, both at -10 degrees C., be brought together, what happens? Exactly how does it happen, i.e. what is the mechanism by which it happens?”

Slide 21: graduating class

WKL went to do graduate work in Breslau, Germany,

Slide 22: dissertation

returning to US 1908 for a year or two or work in industry (tannery) – then to MIT

Slide 23

By 1909 more degrees in chem. Eng than in chemistry (two to one between 1909-14)

Tremendous demand in WWI

Walker was put in charge of Edgewood Arsenal, to synthesize toxic gases, “manufacturing new products by processes that were likewise almost wholly new” 250 officers and 7000 men– WKL in charge of gas mask design, the masks in the basement of his Newton home

Not just war demand, also need to develop domestic industry to substitute for non-available imports

Tension continued at MIT

Noyes more traditional lab chemistry approach became more and more marginal under pressure from Walker, Noyes left in 1919 to become president of Cal Tech (Servos 533) –

Walker left too - concept of internship, promoted by Little, took shape as School of Engineering Practice (internships in US industries in cement, dyes, gas and coke., etc.) – had plan for division of industrial coop and research, helped raise endowment, industrially sponsored research, led to complaints about quality of work done under this plan –

President Maclaurin died, “the development of the idea became impossible and I dropped out of educational work”

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1921 Course X became separate dept., Lewis as head – worked closely with petroleum industry, fluidized bed catalytic cracking

Summary

Male

Crucial input of new knowledge base

being educated to work with industry but with long view (value of eng. sci)

purpose of industry is low-cost production for mass market –

WKL when he went to grad school in Breslau, a great industrial city of Germany: “I saw the piling for the foundations of a new, large, modern business building driven by workmen on the ends of a cat-o’-nine tails; in this country I had never seen such work done other than by a donkey engine, even on construction in backwoods areas. America had to keep costs down by every practicable device to increase the efficiency and effectiveness of human labor. Mass production was the solution of the problem.”(new science, 9)

Stimulus of war too

Engineering today: general decline

Mass production cheaply: this has been outsourced – where will jobs come from?

Innovation serves economy not people

National security? But the systems we build have become a source of insecurity (ever

since gas warfare: “instant conversion” from civilian to military purposes

Health care? 14% of US GNP, unaffordable, corrupted by conflict of interest

Environmental costs of technological progress

Not so obvious what progress means: or rather technological progress doesn’t necessarily mean historical progress

Back to Laurel: photo was from selling the farm in 1952

What changed wasn’t the farm/farming but the whole “surround”

Tomatoes from California and hothouses

The Dual (Rt. 13) going in in forties to connect Wilmington with Seaford – DuPont plant there opened to make nylon (1939)

Bay Bridge opened it up to vacation homes
on Ntl Register,, had been B&B, barn as antiques shop
Chemical eng. brought not improvement of a beloved way of life, but a whole other way
of life – a much better world but not the one he loved – as true for engineers as for
everyone else: not just improving nature, but replacing it with another environment

Slide 37: Morison

Slide 38: not just human imprint on world

Technology making possible formerly unallowable processes and events, or at least not
on this earth

Climate change: release of fossil fuels (for so long the dominant form of chem. Eng) –
possible non-linear effects, a vast open air experiment, “risk society”

Biological engineering – new organisms, modes of reproduction

Nuclear energy – WKL’s work during WWII, his fears,

Lots of action, few controls; innovation without boundaries; space of action keeps
expanding and getting beyond ability to control

Not right-left, not Luddism, not nostalgia, not utopianism

Nor is it a matter of engineering anymore – engineers solve problems, but the problems
of humanity are larger than engineering: are of civilization in a self-created habitat

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Deeply integrated approach is needed

WKL’s conclusion: wanting to come back as a social scientist

the engineer alone can have the breadth of understanding of the industrial situation which
will be needed to furnish leadership in the future. The educational leaders of this
generation will rise to the challenge as did the leaders in the chem eng field a half century
and more ago.”(Evo 8)

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