The social context and politics of technological systems

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Lecture Abstract

There is a widespread belief that the success of large technological systems (Mumford 1966) is solely a question of the right design, the appropriate engineering principles and the best technology (which itself is often treated as a derivative of science). As a result, innovators, engineers and policy-makers tend to overlook the ways in which technology is taken-up, transformed and deployed – often in wholly unpredictable ways – by both society at large and users, who are usually seen as passive recipients that adjust to the technological system in question.

Through an analysis of several case studies, this lecture first highlights the social pitfalls and political stakes of such an approach. We examine the failure of the introduction of the electrical vehicle in France in the 1970s (Callon 1986), the institutional resistance of the US Navy to weapon reform in the 1890s (Morrison 1966), the persistence of the QWERTY keyboard, despite the availability of more efficient alternatives (David 1985; Diamond 1997); the divergence in purpose between designers and users of the French Minitel (Feenberg), and the politics built into the construction of the rail network in 19th century England or the Long Island (LI) parkway in New York in the 1950s (Winner 1980).

In the second part of the lecture, we draw out the lessons from these case studies: the need for constant vigilance in the introduction of large-scale technological projects (electric vehicle); institutional constraints (gunfire at sea); blind commitment through path dependence (QWERTY); user unpredictability and the inehrent ambivalence of technology (Minitel); and political interests (LI parkway and 19th century railways in England). We then (tentatively) offer some solutions that might help ensure the success of technological systems. These include the idea of the actor-network (Callon 1986) and the heterogeneous engineer (Law 1987; 1992); a repertoire of entrepreneurial skills that help to overcome organisational resistance to change (Dalgliesh 2007); the notion of society and technology as reciprocal entities that evolve in tandem, if not the former as an effect of the latter (Latour 1983); and attempts to bring on board lay participation in the development of technological systems, as well as the use of philosophical critique in parallel to that of technical expertise (Dalgliesh 2012).

Opening remarks

Apologies

Perspectivism

- S&T might claim a universal remit and be applicable everywhere
- *Critical* philosophy, however, cannot do likewise, hence …
    - Analysis and ideas betray the perspective from which I work
    - Exacerbated by case studies drawn from non-Indian context

Bridging disciplines

- Philosophy venturing into the technical world of S&T
    - Intention is to speak of S&T's *context*, not its *content*
- Conference and workshop lectures are necessarily short, too
    - Remain at the general level to facilitate dialogue across disciplines

Lecture outline

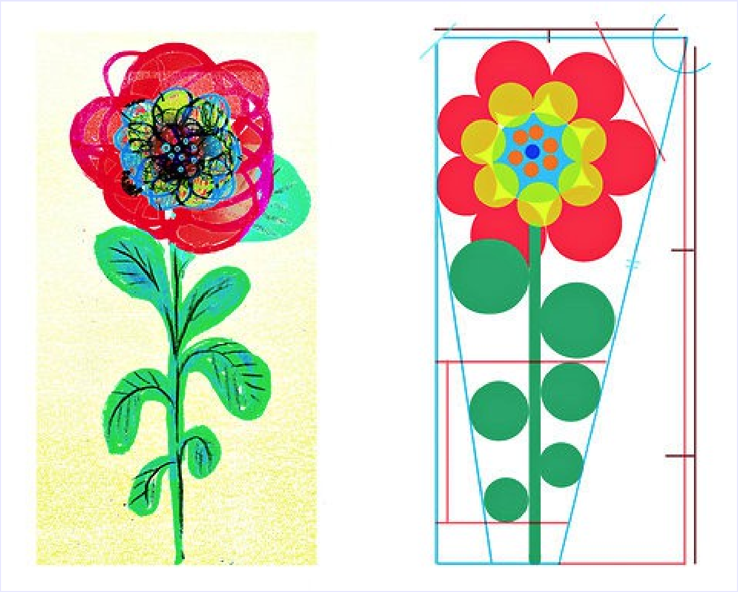
Philosophy *of* or *about* technology? 1

Analytic (AP) versus Continental philosophy (CP)

- AP & CP are 20th century deterritorial intellectual classifications
- Bridges do exist between AP and CP, though differences persist

AP and CP differ in *purpose* of philosophy

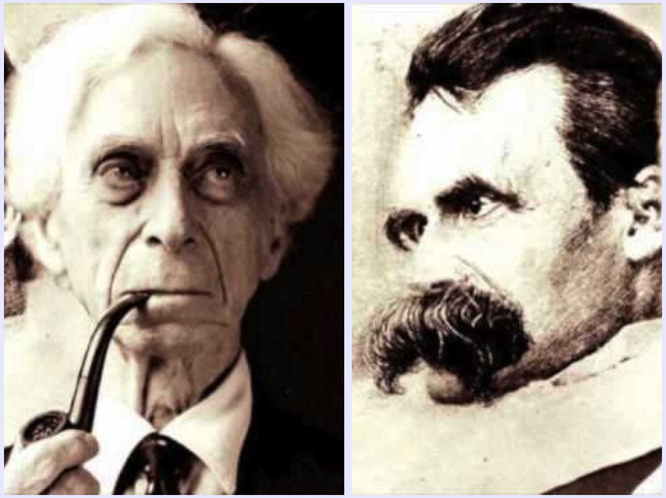
- AP → theorisation via logic, rigour, empiricism, explanation
  - Key is to provide answers and analytic resolution of problems
- CP → evaluation via style, rhetoric, genealogy, hermeneutics
  - Key is raising questions and difficulties and *problématisations*



Philosophy *of* or *about* technology? 2

AP and CP differ in *focus* of philosophy

- AP → scientificity of knowledge via an apolitical analysis
  - What is belief, the correct method, observation or knowing?
- CP → cultural criticism of subjectivity and politics of knowledge
  - Present is understood textually or contextually (vs. eternally)



Bertrand Russell

Friedrich Nietzsche

Philosophy *of* or *about* technology? 3

AP’s ‘engineering’ philosophy *of* technology

- Internalist → describe T without reference to social context
  - Examine the making, using and simple history of artefacts
- Empirical analysis of engineering to produce useful concepts
  - Dreams of a unifying ‘technophilosophy’
- Little criticism of the social and cultural impacts of T

CP ‘humanities’ philosophy *about* technology

- Externalist → focus on social impact of T and vice versa
- Undertaken by philosophers with little engineering b/ground
- How is it we’re something (versus nothing)?
  - Technology makes human existence possible
  - Humanity depends on, makes daily use of and develops and evolves due to technology

CP *about* technology – artefacts 1

‘Machines’ or ‘tools’

Things created by human beings for their survival

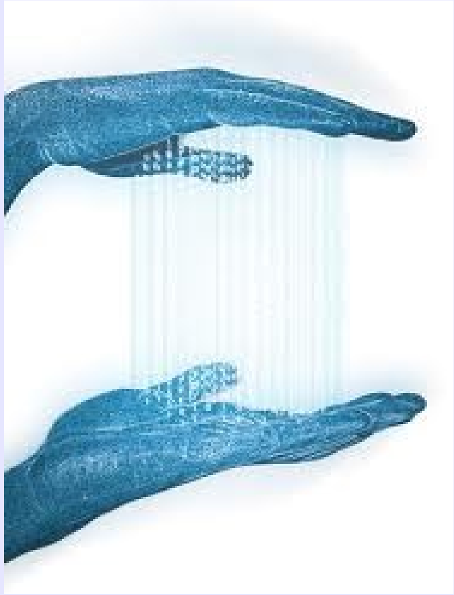
- *Homo faber* → a mental capacity of human beings to make things

Without technical ability humans would be extinct

- (As cultural beings) humans are more dependent on artefacts
- Tools and techniques distinguish humans
- (Humans say) humans are more creative with tools and techniques

CP *about* technology – technique 1

‘Know-how’ (or *savoir-faire*)



Human existence linked to ability to invent techniques

- Rationalised methodology required for making and manufacturing

Technique → transcend relatively meagre physical endowments

- Defines humans as distinct, different and dependent (Rousseau)

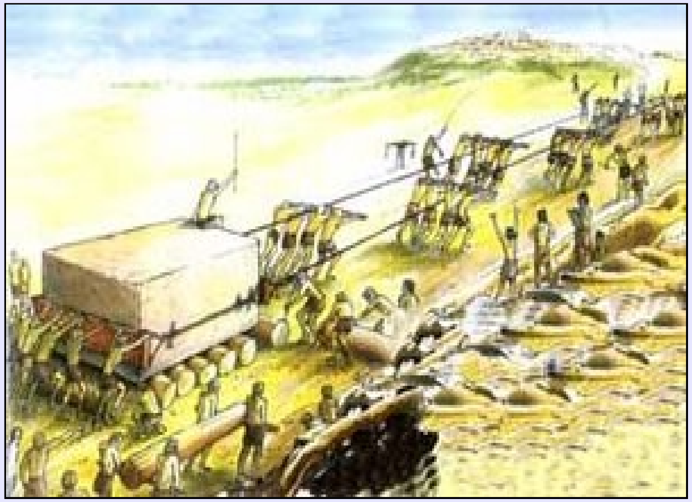
Artefacts + techniques = conditions for thinking

CP *about* technology – manufacture 1

Socio-technical system of manufacture

- ‘Engineering’ (or organisation)

System of organisation



- Development, production and employment need collective effort
- Organisation links and integrates tools and techniques

E.g., ‘megamachines’

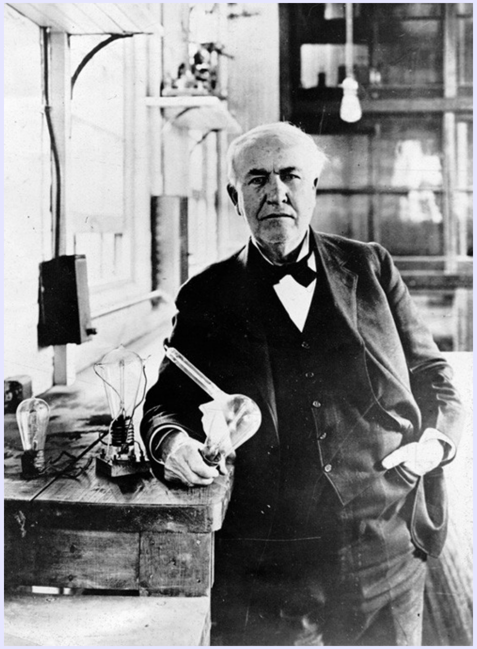
[A megamachine is] a machine composed of a multitude of uniform, specialized, interchangeable, but functionally differentiated parts, rigorously marshalled together and coordinated in a process centrally organised and centrally directed: each part behaving as a mechanical component of the mechanised whole: unmoved by an internal impulse that would interfere with the working of the mechanism.

Lewis Mumford (1994), 'The First Megamachine', in D. L. Miller (ed.), *The Lewis Mumford Reader* (Athens: University of Georgia Press), p. 318.

CP *about* technology – deployment 1

Socio-technical system of use

- Tools + techniques + manufacturing = system
- I.e., devices and artefacts + know-how and skills + socio-technical systems of manu-facturing and organisation + *people to want, desire, use, deploy, maintain or repair them*



Thomas Edison

Purpose → extend human capacities

- Quantitatively and qualitatively

System indicates interconnection

- E.g. Edison’s light bulb → long-lasting bulbs require filament + (air) vacuum pump + electric generator, capital to lay electric cables, metering devices + desire to live by night or read by light

CP *about* technology – deployment 2

Parts of the system develop unevenly and reactively

- E.g., the bicycle depended on advances in tools and know-how
- But the bicycle also required a socio-technical world to use it
- E.g., road networks; cycle lanes; urban transport from home to factory (⇡ ⇣ horse transport and pollution); vehicle for leisure time; women's liberation and upheaval of Victorian values

System is the whole that makes the parts function

- E.g., Shah's attempt to modernise Iran in the 1960s
- Importation of aircraft and computers, but without any operators and service personnel they remained on the ground

Artefacts cannot function outwith a system

Case study 1: The *véhicule électrique* (VEL) 1

Électricité de France's (EDF) social vision of VEL

- VEL geared for post-industrial and post-conspicuous consumption
- Cf., industrial society: high status car and polluting fuel engine

EDF's technical vision of VEL: actors

- *Compagnie Générale d'Électricité* → batteries
- Renault → car chassis and body
- Government → regulate, subsidise, reform

EDF's technical vision of VEL: actants

- Accumulators, fuel cells, electrodes, catalysts, etc.

EDF the prime-mover in creating a new world

- Determines, controls and orchestrates entities and their linkages

Case study 1: Lessons from the VEL 1

Failure of EDF's VEL

- Renegade Renault + battery complexity + actor-network fell apart

Lesson 1: the heterogeneous engineer

- Constructs a socio-technical world and defines relations and links
  - Laboratory → control centre for making society via technoscience

Lesson 2: the heterogeneous engineer's skills

- Translator-spokesperson
  - Enrols entities + attribute roles and identities
- Translator-strategist
  - Obliges courses of action + endeavours to black-box linkages
- Translator-displacer
  - Actualises, aggregates, negotiates through research centres, meetings, conferences, facilities and communication control

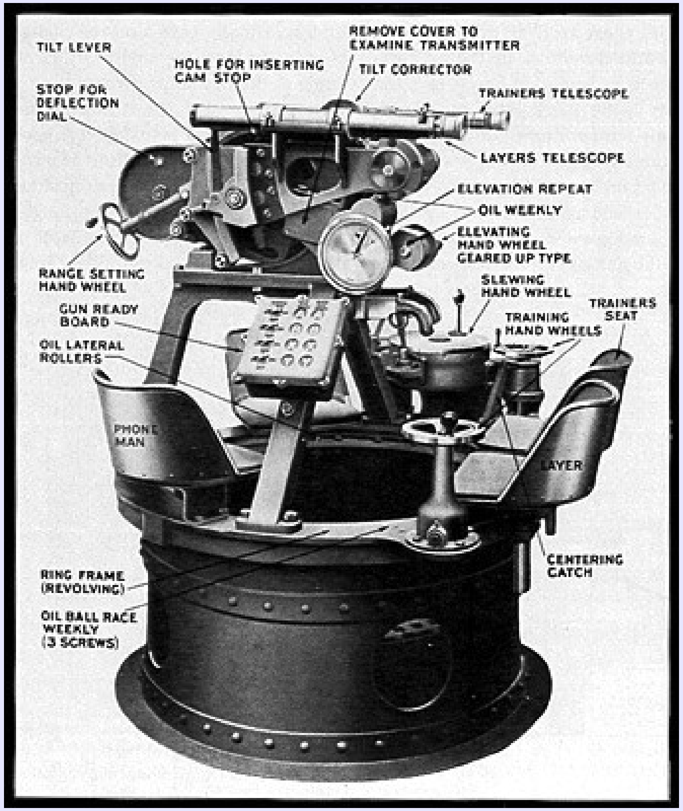
Case study 1: Lessons from the VEL 2

Lesson 3: heterogeneous engineer's actor-network

- Theories weave together human and non-human actors
  - Key activity of scientists and engineers is to assemble and insert human and non-human actors in stable network nodes
- Consequence of the process of building networks
  - Scientists and engineers produce contingent binary divides
    - E.g., nature-society, technology-culture, S-T, individual-society
  - Nature and society are not pre-given entities to explain other entities, but the outcomes of the work of doing technoscience
- Networks are an ongoing process
  - Without constant enactment of the relations and practices that bind and link them, institutions and actants disappear
- Consequences of S&T as processes → networks
  - Realities and structures are precarious in principle
  - Implies the world might be different → new possibilities

Case study 2: Continuous aim firing (CAF) 1

CAF in the British Navy

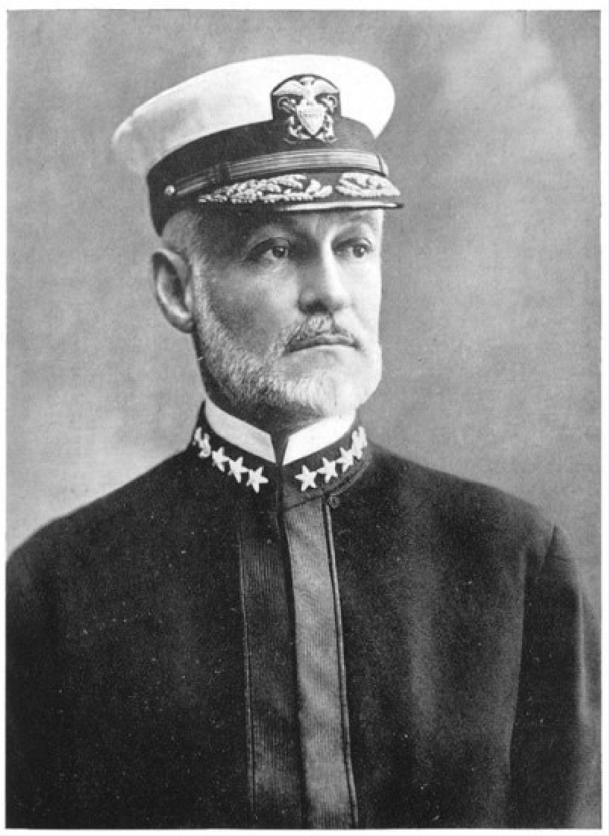


- Sir Percy Scott and British Navy
  - *Art* of manual aim firing (MAF)
    - Roll of the ship
    - Estimate the target's distance
    - Firing interval
  - *Science* of continuous aim firing
    - Gear ratios
    - Telescopic lens
    - Target practice
- Evidence for changing MAF → CAF
  - Gunnery accuracy increased 3 000% in 6 years in the British Navy
    - 5 ships fired 5 minutes (target 1600 yards) → 2 hits (1899)
    - 1 gunner fired 1 minute (target 1600 yards) → 15 hits (1905)

Case study 2: Continuous aim firing (CAF) 2

CAF in the US Navy

- William Sims (Captain → Admiral) and US Navy reform
- 13 reports on revolutionary CAF
  - Silence
  - Rebuttal
  - Dispute
- Sims appointed Inspector of Target Practice by Roosevelt in 1902
  - Credited with introducing CAF to the US Navy



Case study 2: Lessons from CAF 1

Technological change: determination + serendipity

- Sir Percy Scott
  - Sagacious → bridge builder and visionary
    - Guns on ships + elevating gears + telescopic lens
  - Personality → embittered + anti-establishment + amateur expertise
- William Sims
  - Outsider
  - Zealous
  - Initiative

Organisational obstacles to change

- Resistance is ‘natural’ → routine + habit + vested interests
- Limited identifications → parts do not see the whole

Case study 3: QWERTY keyboard 1

QWERTY keyboard layout

- 32% of strokes on home row (including J and K)
- 52% on upper row (including E, T and O + one vowel)
- 16% on bottom row

Limits (efficient) typing via alternating hands

- Vowels and consonants are split between left-hand and right-hand
- E.g., ‘exaggerated’ or ‘million’ (‘pumpkin’ for up/down motion)

Skills and ability

- Average QWERTY typist's fingers travel 32 km per day
- 56 hours training to achieve 40 words/minute

Case study 3: QWERTY keyboard 2

DVORAK keyboard

- 70% of strokes on home row (all vowels and T, H, N)
- 22% on upper row
- 8% on bottom row (rarest letters V, K, J, X, Q and Z)

Skills and ability

- Average DVORAK typist's fingers travel 1 km per day
- 18 hours training to achieve 40 words/minute

So why is QWERTY dominant?

Case study 3: QWERTY's dominance 1

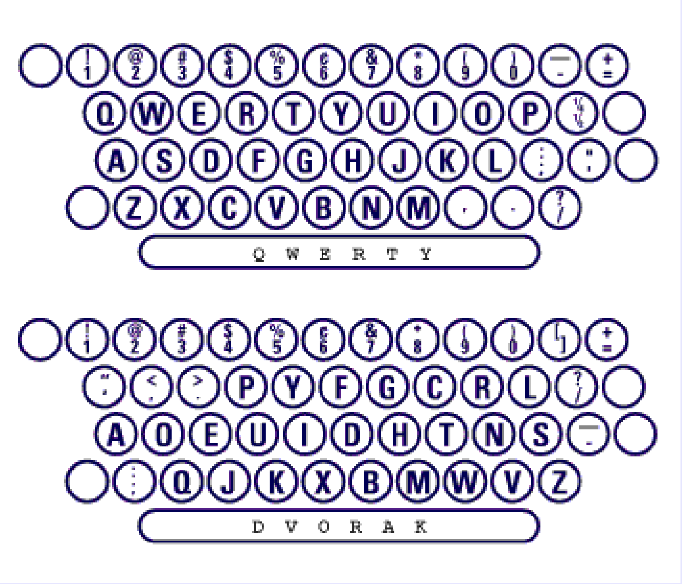
Period of flux (1880-1920) & shake-out (1874-1881)

Christopher Sholes's QWERTY design

- Solved key jamming

Early pioneer through Remington

- Offered key features, e.g., ink ribbon; cylindrical paper cartridge



Rival manufacturer Underwood

- Used QWERTY

User's skills based on … QWERTY

- US Treasury vetoed US Navy's switch to DVORAK

Case study 3: Lessons from QWERTY 1

Market failure

- Should govt. regulate first-mover advantage when it prevents a superior technology from developing?

‘Natural’ path dependence

- Produces ‘blind’ commitment irrespective of merits of technology
- ‘Locked in’ to an inferior technology despite rational arguments
  - Complimentary goods become more attractive → attract people to adopt the technology ← feedback effect that reinforces QWERTY
  - Switching costs prevent changing to a better technology

A *path-dependent* sequence of ... changes is one in which important influences upon the eventual outcome can be exerted by temporally remote events, including happenings dominated by chance elements rather than systematic forces. Stochastic processes like that do not converge automatically to a fixed-point distribution of outcomes, and are called *non-ergodic*. In such circumstances, ‘historical accidents’ can neither be ignored, nor neatly quarantined …; the dynamic process itself takes on an *essentially historical* character. for the purpose.

Paul A. David (1985). ‘Clio and the Economics of QWERTY’. *The American Economic Review* 75(2): 332-337. Available at http://www.decon.unipd.it/personale/curri/birolo/materiale_corso/internet/David_QWERTY.pdf

Case study 4: the French Minitel 1

France Télécom's (FT) vision for Minitel

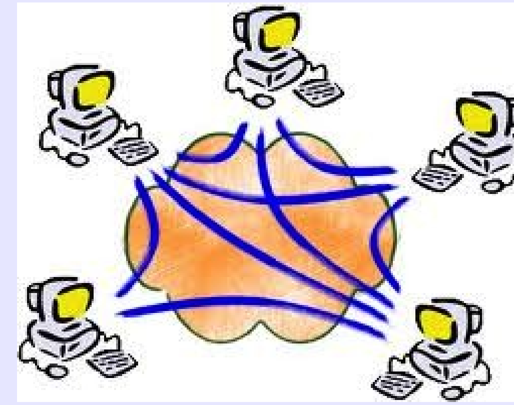
- Exhorted by state driven modernisation
  - ‘Telematics’ the key weapon
- FT used existing Teletel cable network (1982)
  - Transmission via Videotex software
- FT gave away 6 million Minitel terminals
  - Mail-order products, train and plane tickets, news and information services
  - Subscriber usage billed monthly
- FT vision of passive users → Minitel = telephone directory

FT intention → rationalisation

- Minitel a process towards a high-tech. information society
- Post-industrial completion of universal enlightenment

Case study 4: the French Minitel 2

User’s vision for Minitel



- Hackers broke into a Minitel site and sent messages to users
  - Anonymity of interaction hitherto unknown
  - Corporate reaction → try to profit from user-2-user *information* platform

User’s intention → democratic (bottom-up) rationalisation

- Minitel first instant messaging platform
- Used to find a date → *communication* platform
  - E.g., Désiropolis; Sextel; Pink

Case study 4: Lessons of the French Minitel 1

Technocratic solutions are not watertight

- Human dimension of taking up with technology is unpredictable
- Emerges downstream of the vision of the engineer and designer

Technologies are ambivalent and contingent

[T]echnology is not a thing in the ordinary sense of the term, but an 'ambivalent' process of development suspended between different possibilities. This 'ambivalence' of technology is distinguished from neutrality by the role it attributes to social values in the design, and not merely the use, of technical systems. On this view, technology is not a destiny but a scene of struggle.

Andrew Feenberg (1991). *Critical Theory of Technology* (Oxford: OUP), p. 14.

Technologies are (potentially) undemocratic

What human beings are and will become is decided in the shape of our tools no less than in the action of statesmen and political movements. The design of technology is thus an ontological decision fraught with political consequences. The exclusion of the vast majority from participation in this decision is profoundly undemocratic.

Andrew Feenberg (2002). *Transforming Technology: A Critical Theory Revisited* (Oxford: OUP), p. 3.

Case study 5: Long Island parkways 1

Politics through technological systems

- Travelling on a road or train ← transport system is innocuous
- Long Island, New York
  - Jones Beach State Park leisure and beach facilities
- Long Island parkways
  - Many overpasses are only 9ft high
  - Prevent 12ft buses from crossing
- Political effect of the parkways
  - Racial minorities and low-income groups are denied access
- Robert Moses
  - NYC urban developer 1920s-1970s
  - Technological projects → efficiency and progress, or social engineering and exclusion and sometimes domination?

Case study 5: Lessons of Long Island parkways 1

Technological politics

- Artefacts designed to produce effects independently of their use
- Consequences logically prior to any professed usage of T

Street benches

- E.g., no homeless people

Population control

- E.g., crowd control through anti-loitering mosquito alarm

Caveats for technological systems 1

Heterogeneous engineer and the actor-network

Repertoire of entrepreneurial skills

Path dependence

Unpredictability of technological projects

- Lay participation in the development of technological systems

Technological politics

- Use of philosophical critique in parallel to technical expertise

Technoscience: reciprocity of society & technology

- Society and technology are reciprocal entities that evolve in tandem, if not the former as an effect of the latter

Caveats for technological systems 2

Technoscience versus science and technology

- Refuse formal science → technology = applied science vision

Technoscience is Janus faced

- Science in the making → during the process of technoscience, nature and society are contingent and ordering is controversial
- Technoscience is the creation of larger and larger networks
  - Cf. power politics based on mobilising alliances and interests
- Ready made science → once techno-science has black-boxed controversies, S&T are seen as having always been true

Janus (God of beginnings & transitions

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