HIS 2129

Technology, Society and Environment since 1800

(Winter 2014)

A Primer to the Humanities

- Services
  - **Student Mentoring Centre**, 125B Simard Hall, arts.mentor@uOttawa.ca
  - **Student Academic Success Service**, http://www.sass.uottawa.ca
    - **Access Service**, UCU 339, http://www.sass.uottawa.ca/access
    - **Writing**, http://www.sass.uottawa.ca/writing

Student Responsibilities (www.uottawa.ca/academic/info/regist/crs/0305/home_4_ENG.htm)

- "attend classes"
- "understand what constitutes academic fraud and plagiarism"
- "regularly consult their e-mail at the address assigned (@uottawa.ca), which the University will use in all communications with students"

The 14th year of the 21st century…

- The Western calendar does not have a year 0
- It begins with the purported year of birth of a Jewish heretic, Jesus of Nazareth, expressed as 1 AD or CE
- Therefore, the 19th century includes the years 1801 to 1900, and the 20th century the years 1901 to 2000
- So, we are now in the 21st century of the Christian (or Common) Era

Outline

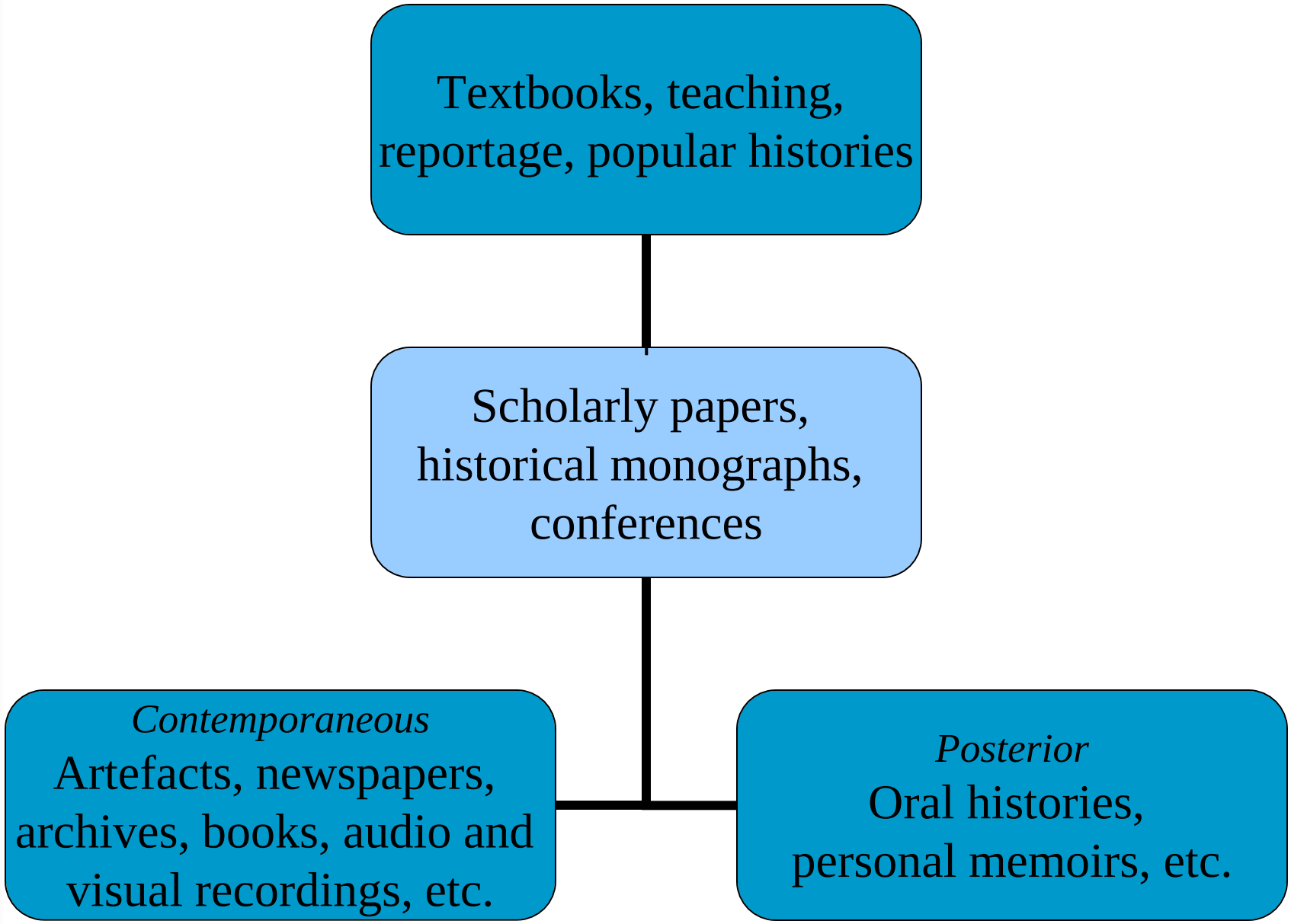
- What is history?
- Why this course?
- What is technology?
- — Origins and consequences
- — Technology in history
- — The history of the word *technology*
- — The history of the concept
- — Telling the story of technology
- — The role of technology in our world

What Is History?

- "These are the **researches** of Herodotus of Halicarnassus, which he publishes, in the hope of thereby preserving from decay the remembrance of **what men have done**, and of preventing the great and wonderful actions of the Greeks and the Barbarians from losing their due meed of glory; and withal **to put on record** what were their grounds of feuds." — Herodotus of Halicarnassus, 440 BCE

- History is:
- (i) a subject matter (what happened: "what men have done")
- (ii) a process (finding out what happened: "researches")
- (iii) a narrative (telling what was found: "to put on record")

The Historian's Food Chain

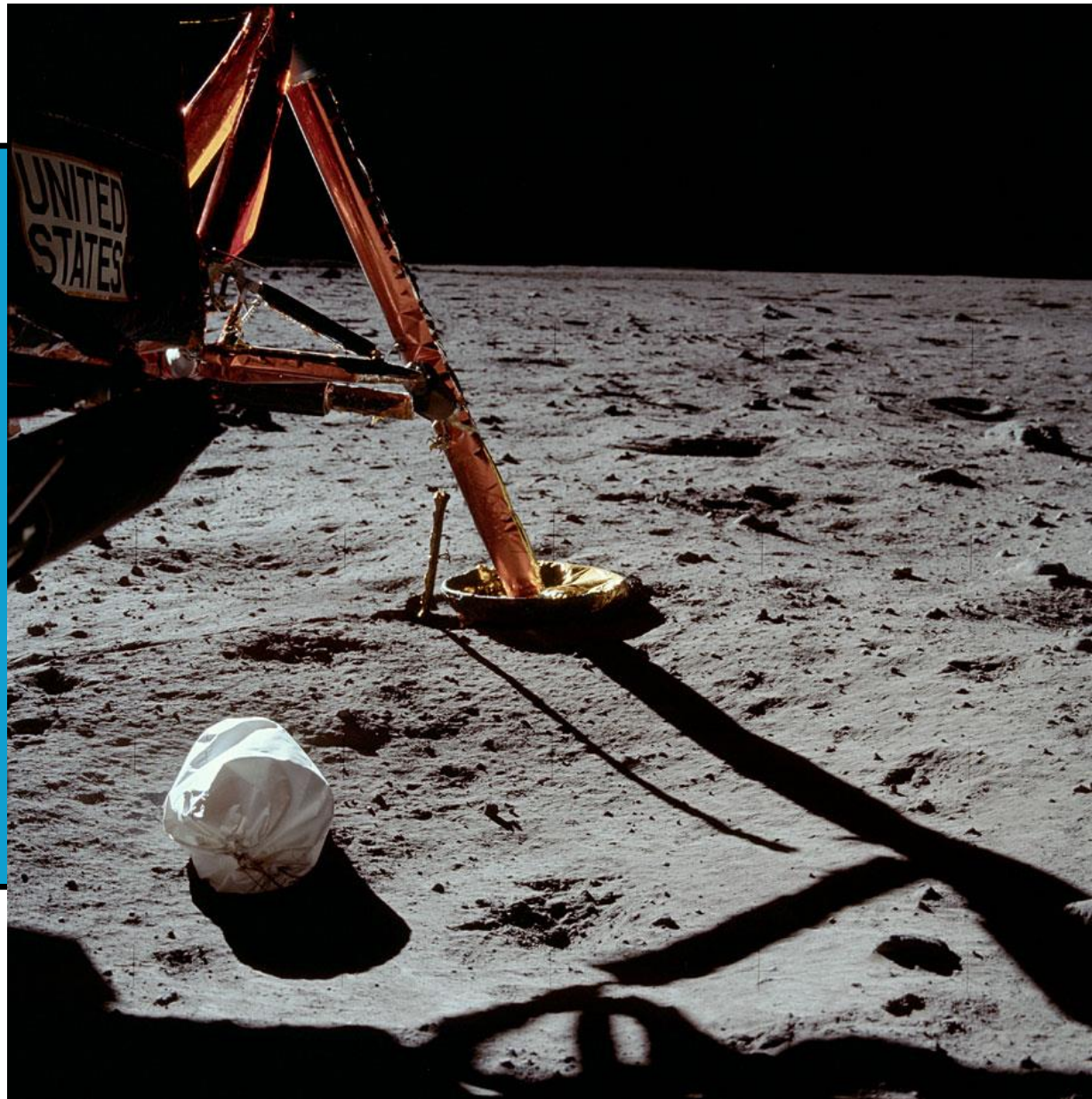


Why ask why?

- “I fully agree with you about the significance and educational value of methodology as well as history and philosophy of science. So many people today—and even professional scientists—seem to me like somebody who has seen thousands of trees but has never seen a forest. A knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering. This independence created by philosophical insight is—in my opinion—the mark of distinction between a mere artisan or specialist and a real seeker after truth.”
  - Letter from Albert Einstein to Robert Thornton, 7 December 1944

1969: Technology and Environment

Five minutes before Neil Armstrong set foot on the Moon, he dropped this "jettison bag" containing empty food bags and other trash. Eight minutes after that first step, Armstrong snapped the first pictures taken by a human on the Moon and started, for technical reasons, with this landing strut.



NASA Johnson,
Processed by Kipp Teague

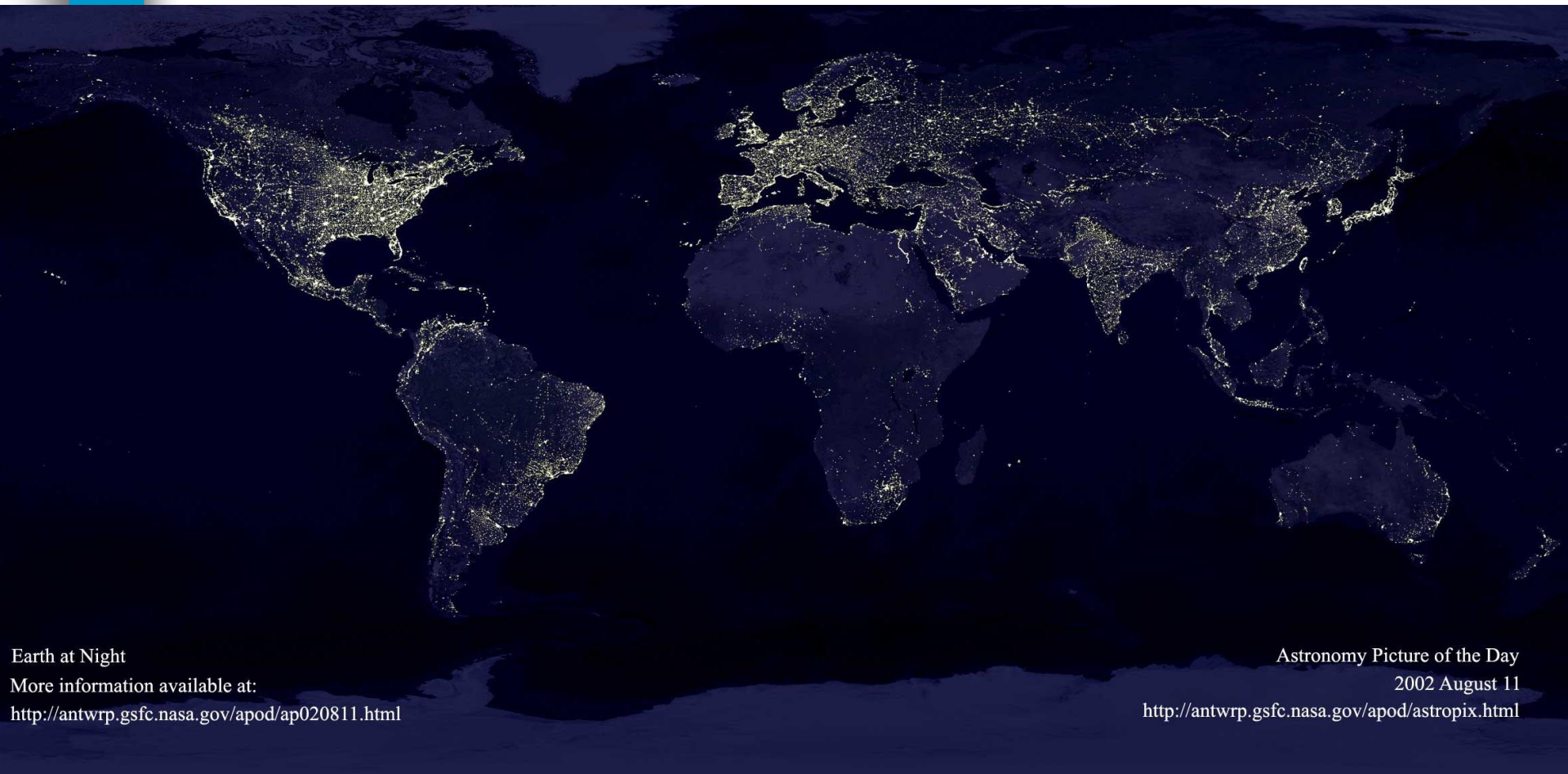
Spaceship Earth (1968)

NASA, Apollo 8 mission

- The human impact on the Universe…

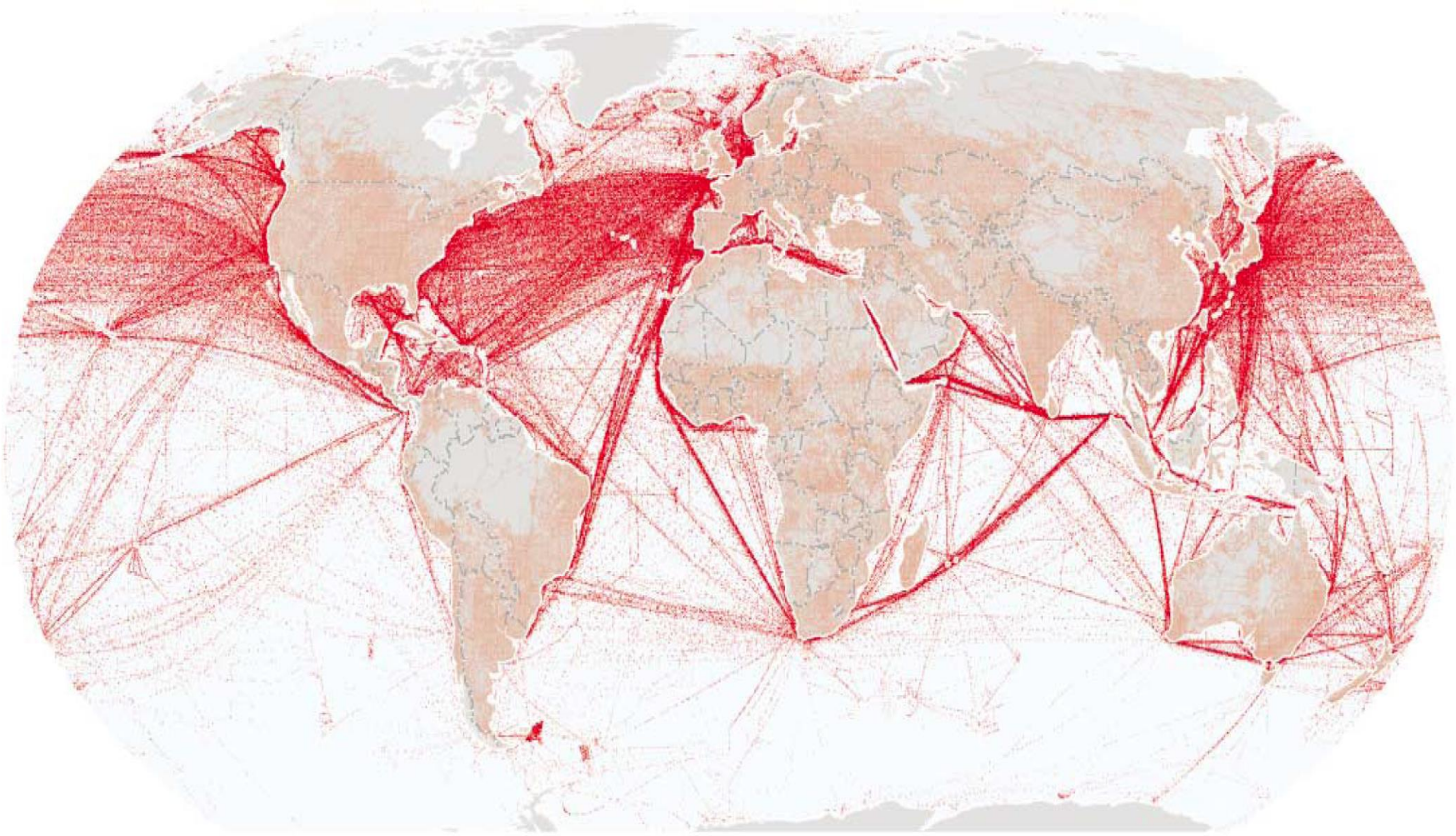
Earth by night (11 August 2002)

Part of the energy used by humans goes to lighting outer space…



The human impact on Earth (1)

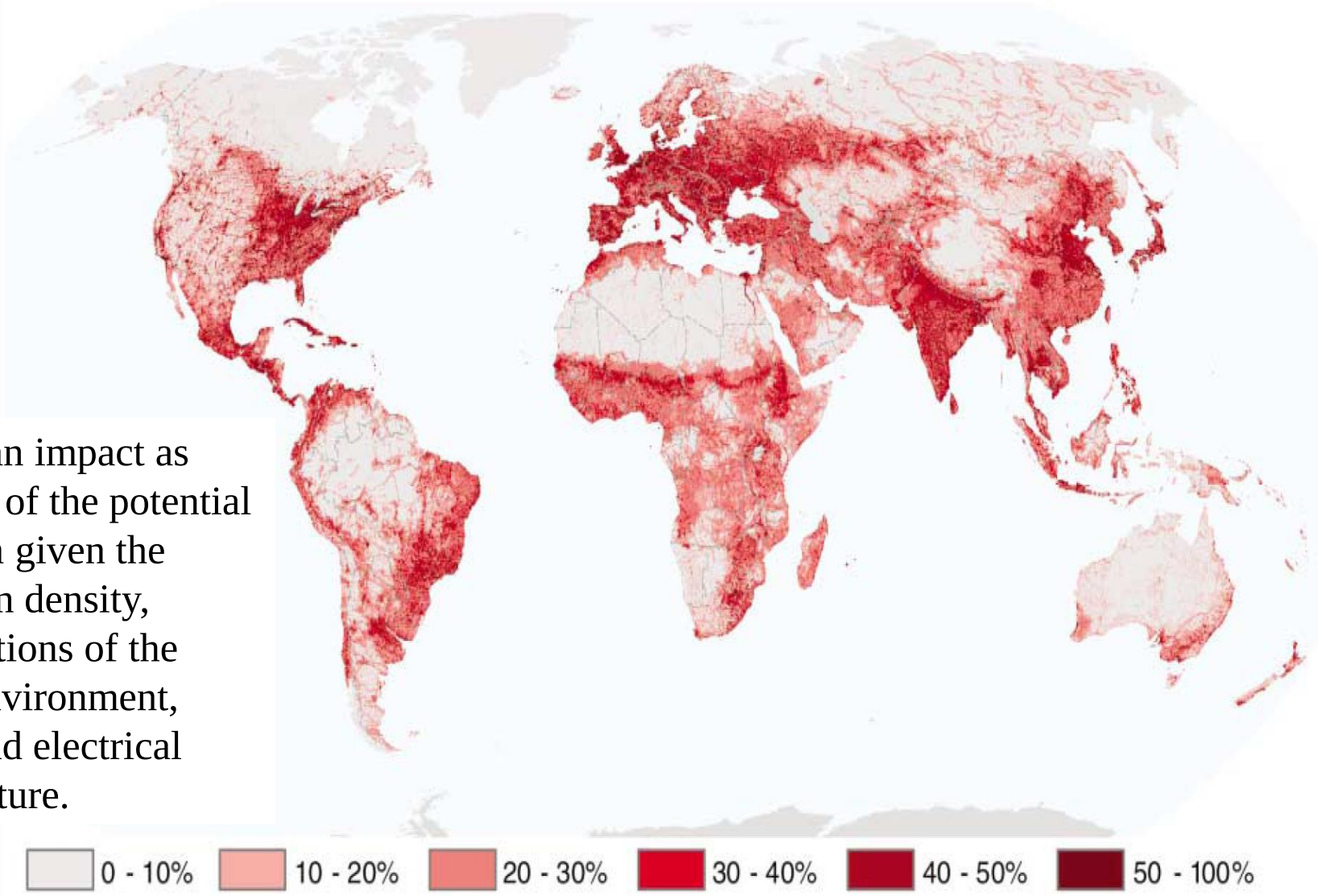
Sea lanes in red and road networks in pink.



Peter Kareiva, "*Domesticated Nature*", *Science* **316** (2007), p. 1866.

The human impact on Earth (2)

The human impact as a fraction of the potential maximum given the population density, modifications of the natural environment, access, and electrical infrastructure.



Peter Kareiva, "*Domesticated Nature*", *Science* **316** (2007), p. 1866.

A Tremendous Human Creation

Hobbs (NM) in 1988 (Picture taken during space shuttle flight STS-61A)

A city, roads, irrigated fields, and oil wells

What Is Technology?

- “The philosophy of technology must deal with a phenomenon which will likely decide the survival of the human race.” — Wolfgang Schirmacher, 1983

- ***The Mandate***: An examination of the role of technology in the social, economic, and environmental changes affecting industrial and "post-industrial" societies. An overview of the interactions between technology, society, and the environment since 1800, with an emphasis on North American developments.

Course goals

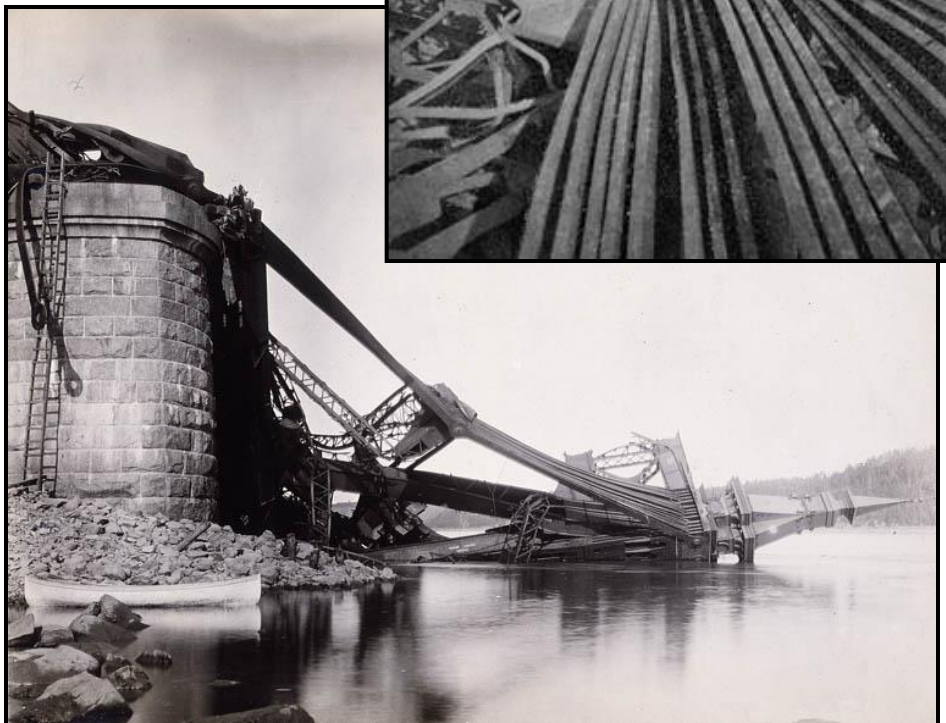
- Gaining knowledge of the history of technology
- Gaining understanding of the history of technology
- Fostering academic integrity
- Exploring the concept of the technologist's ethical integrity
- Fostering reading and writing skills

Paying heed to technology (1)

- In 1895, a locomotive burst through a wall of the Montparnasse train station in Paris, France
- Questions:
  - What is technological error?
  - Does it differ from human error?

Paying heed to technology (2)

- In 1907, the Quebec City bridge over the St. Lawrence collapsed, killing 75 men



Chain of eye-bars on the bridge's top chord ↗
(National Archives of Canada Library)

Piling and collapsed bridge structure, 1 September 1907 ➔
(Courtesy of Dominion Bridge Company Ltd./Library and Archives Canada/PA)

Paying heed to technology (3)

- In 2005, hurricane Katrina overwhelmed the dikes and levees of New Orleans in Louisiana, flooding much of the city

Above:
Boats swept by hurricane Katrina onto Highway 23 in Venice, Louisiana (NARA 5693951, Marvin Nauman, 1 November 2005)

Left:
Flooded neighborhoods and roadways after hurricane Katrina (NARA 5693511, Jocelyn Augustino, 4 September 2005)

Paying heed to technology (4)

- In 2010, a deep water oil well in the Gulf of Mexico blew and was responsible for a gigantic spill: but who or what was responsible?

Ships pull oil into a fire boom in a controlled burn, with a second controlled burn visible in the distance, 17 June 2010 (NARA 6903954, U.S. Coast Guard photo by Chief Petty Officer Bob Laura)

Homo technologicus

- Many animals manipulate their environment (beavers, birds, ants, termites, etc.); a few species are able to use natural objects (stones, sticks, etc.) as tools
- Only humans combine objects into more complex ones and apply outside forces (fire) to their shaping
- Even language may be a product of such technological skill, unless it's the reverse
- Both language and technology are hallmarks of the purely human intelligence (from the Latin *inter* + *ligere*, to interlink, to select from)

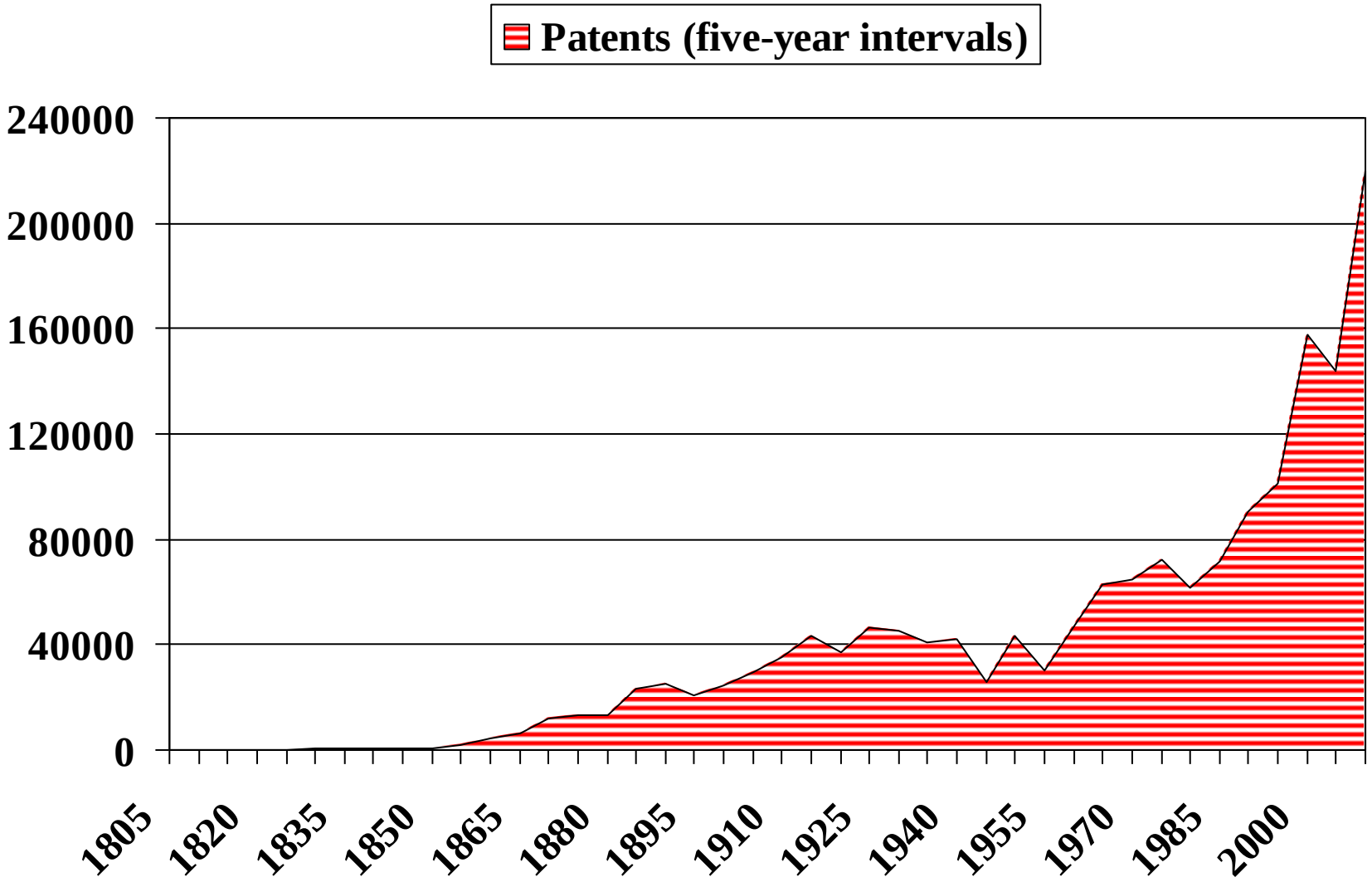
Technology and Progress (1)

- Whether or not progress should be identified with technological change or economic growth, economists have come to recognize that technological change (broadly conceived) has played during the 20th century a role at times more important than purely economic improvements in driving economic growth, especially in developed countries and during the middle part of the 20th century

Technology and Progress (2)

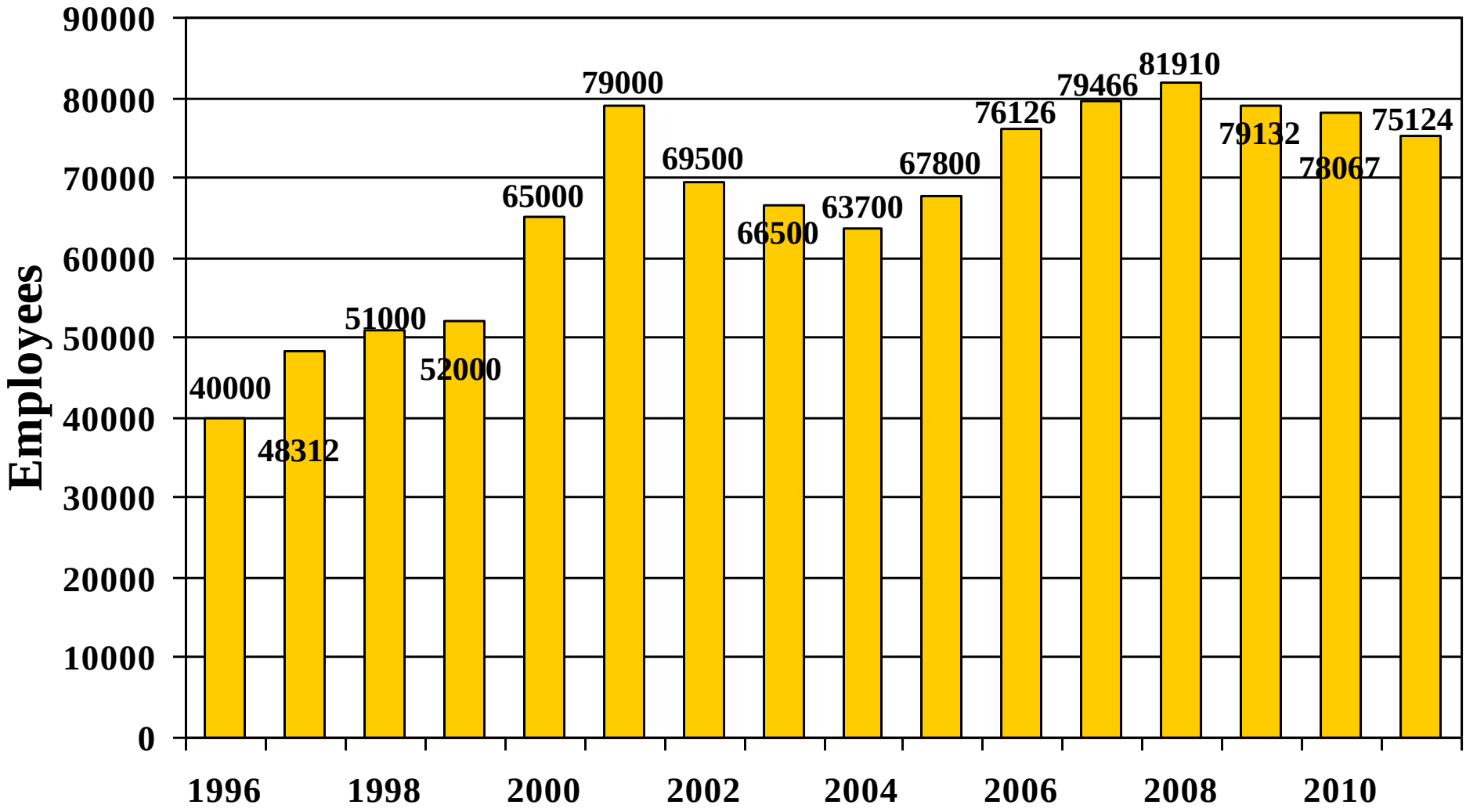
- In 1957, Nobel winner Robert Solow found that increases in capital and labour inputs accounted for only 13% of the U.S. growth rate between 1909 and 1949; the residual was attributed to “technical change”
- Karl Marx (*Das Kapital*) was wrong!
- Later studies of this productivity increase have variously assessed the value of this “residual”; a recent study separated out the evolving education and qualifications of the workforce and pegged the contribution, on average, of productivity changes to 34% of growth in developed countries in the 20th century

United States Patents
(utility patents/of invention, 1805-2010)



High Technology in Ottawa-Gatineau

Total number of (high) technology employees in technology companies in Ottawa-Gatineau.
Source: OCRI Global Marketing, January numbers



Technology and Progress (3)

- Perhaps the most unambiguous good derived from economic well-being is longer life
- The correlation between prosperity and life expectancy is reasonably good at any given point in time
- Interestingly, however, if production can be compared reliably between eras, a discrepancy arises that points to the additional effect of technological change

The Easterlin "Paradox"

(Average annual increase; in years for LE and HLY)

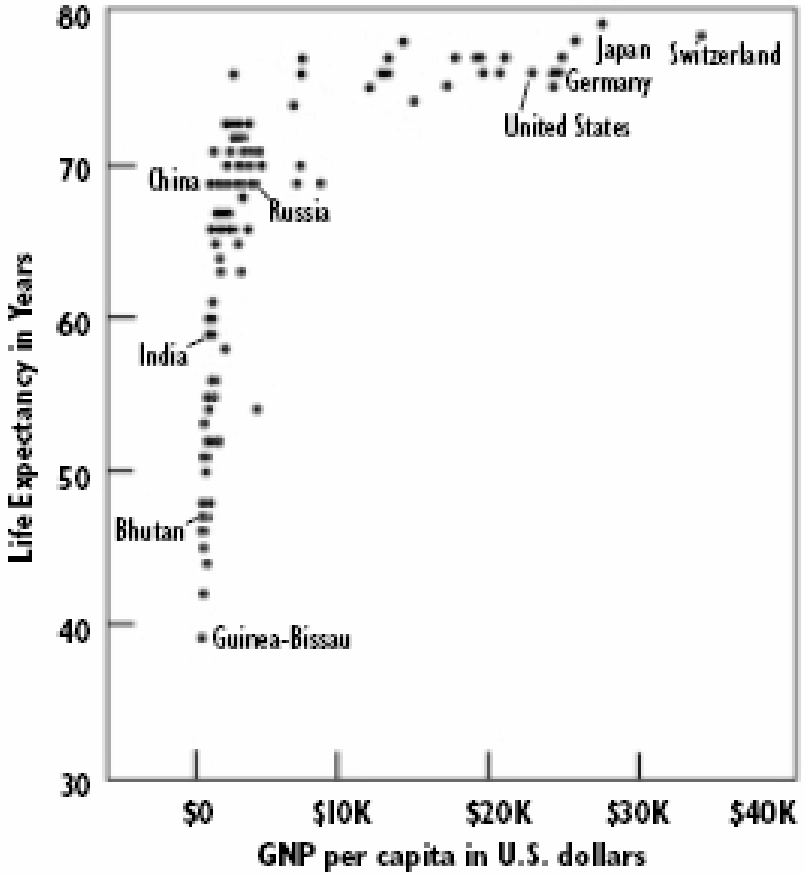
	Period	Happiness	Life Expectancy	Happy Life Years
France	1973-2004	+0.01	+0.26	+0.220
Germany (West)	1973-2004	-0.00	+0.19	+0.151
Great Britain	1973-2003	+0.00	+0.18	+0.152
Ireland	1973-2004	+0.01	+0.19	+0.307
Italy	1973-2003	+0.03	+0.29	+0.398
Japan	1958-2004	-0.00	+0.41	+0.188
Spain	1985-2004	+0.020	+0.07	+0.20
United States	1946-2003	+0.002	+0.19	+0.148

("Happiness" usually being derived from surveys on life satisfaction.)

Veenhoven, R., *Trend Happy-Life-Years in Nations 1946-2004: How long and happy people live*, World Database of Happiness, Trend Report 2007-2, Internet address: http://www.worlddatabaseofhappiness.eur.nl

Longevity for less

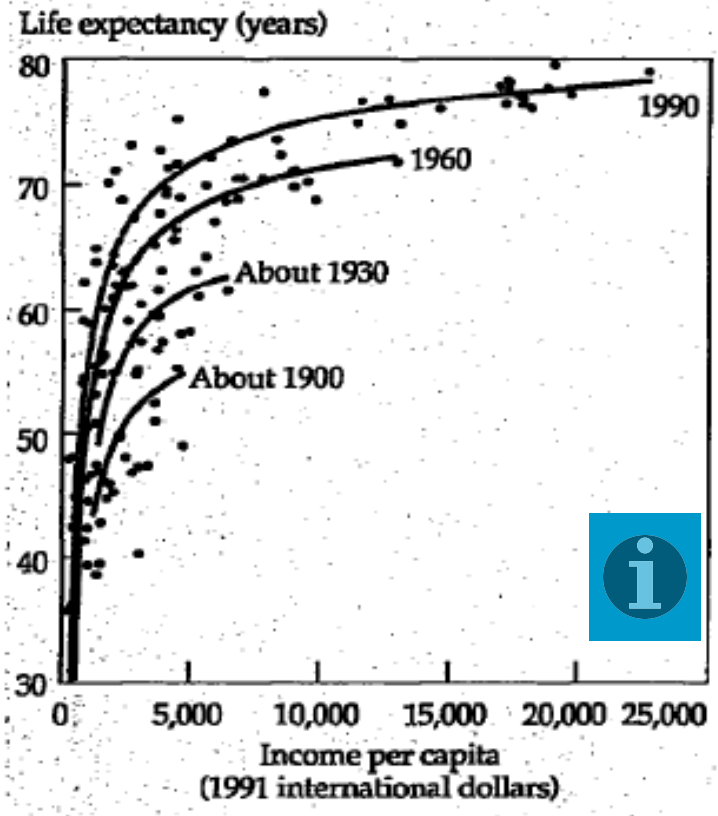
Figure 2: Life Expectancy by Economic Development Level



Mean life expectancy at birth, by GNP per capita in 124 countries.

Source: Data from World Bank, World Development Report, 1993 (New York: Oxford University Press, 1993).

Figure 1.9 Life expectancy and income per capita for selected countries and periods



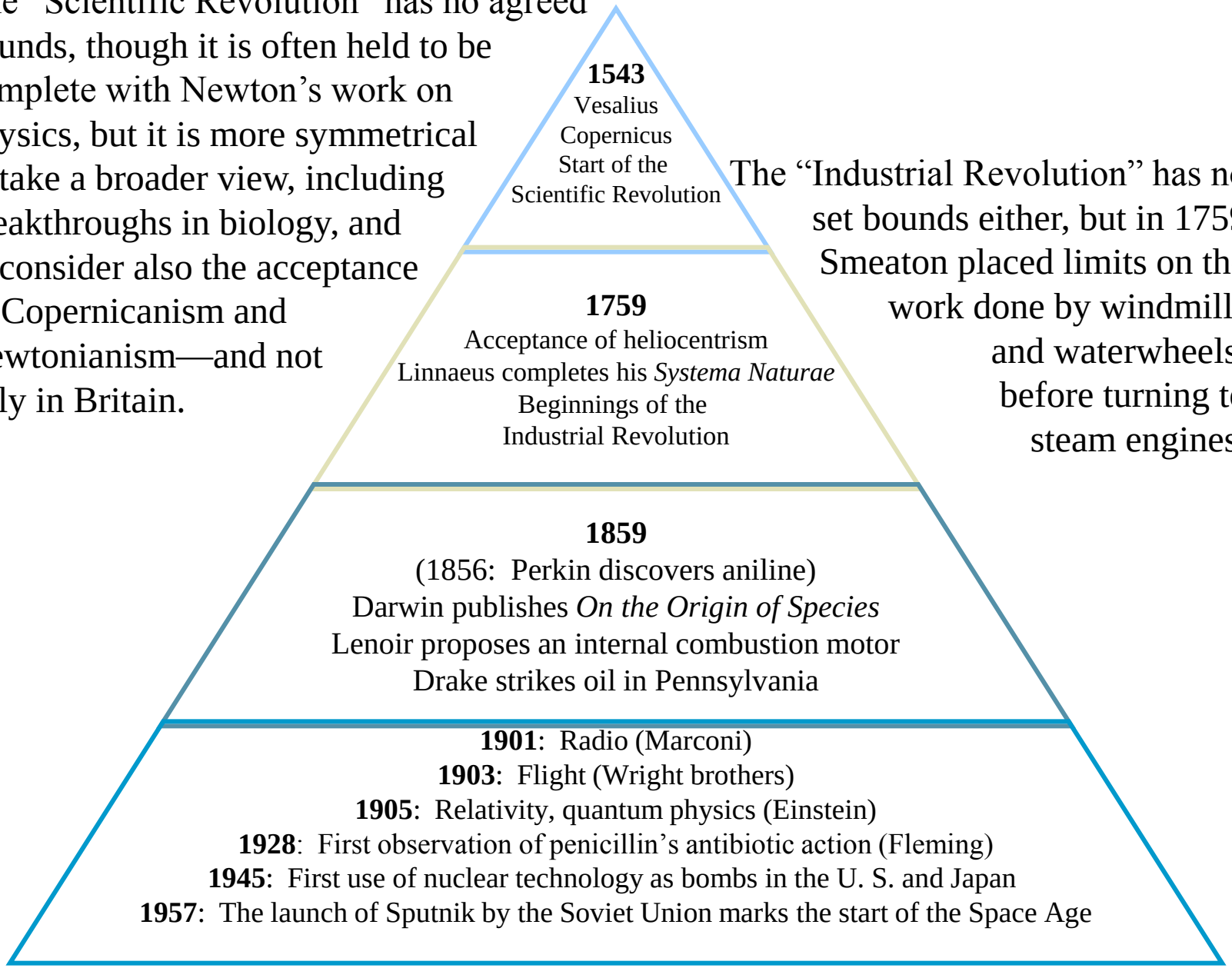
Note: International dollars are derived from national currencies not by use of exchange rates but by assessment of purchasing power. The effect is to raise the relative incomes of poorer countries, often substantially. For illustrative country comparisons and a more detailed explanation, see Table 30 in the World Development Indicators.

Source: Preston, Keyfitz, and Schoen 1972; World Bank data.

From Arts and Crafts to Technology

- The concept of technology is surprisingly recent, even though the most primitive human societies demonstrate a grasp of techniques superior to the achievements of other animal species
- In Antiquity, there was no fixed category corresponding clearly to technology; it was simply the **practical** or **productive** part of the general arts
- Technology becomes a distinct category during the 18th century, just as technological innovations are laying the groundwork for the Industrial Revolution

The "Scientific Revolution" has no agreed bounds, though it is often held to be complete with Newton's work on physics, but it is more symmetrical to take a broader view, including breakthroughs in biology, and to consider also the acceptance of Copernicanism and Newtonianism—and not only in Britain.



The "Industrial Revolution" has no set bounds either, but in 1759 Smeaton placed limits on the work done by windmills and waterwheels, before turning to steam engines.

The History of the Concept (1)

- In Antiquity, the Greeks spoke of the *arts* to encompass both the useful crafts of the artisans and the fine arts of the artists.
- The practical or productive arts were often called “mechanical”, from the Greek word *mechane*, applied to problem-solving, especially when it seemed quite smart, even tricky
- The mechanical arts were soon felt to be vulgar (*banausic*) because they were practiced by craftsmen and slaves; Roman aristocrat Cicero contrasted the *liberal* trades practiced by free men, like architecture or agriculture, with the *sordid* trades of the unfree, which included most mechanical arts

The History of the Concept (2)

- In the Middle Ages, encyclopaedias often listed the arts one by one, without any attempt to generalize
- By the 16th century, Western Europe began to develop new arts and crafts, and even started to encourage the *invention* of new arts and crafts
- The Scientific Revolution of the 17th century did not drive much new invention, but it inspired both scholars and practitioners to approach the arts methodically
- During the 19th century, the useful arts were described by new phrases such as “applied science” or “practical science”, to be studied in “polytechnics”
- By 1861, the founding of the Massachusetts Institute of Technology signalled a shift towards “technology”

The History of the Word (1)

- The Greek roots of “technology” are the words *techne*, meaning *art*, and *logos*, meaning *word*, *speech* or *discourse*
- For Aristotle, technology was an “art of speech”, a systematic approach to speaking and thinking about subjects (often with a specialized lexicon)
- Technology was used in that sense for centuries
- By the 18th century, the word was read differently since *logos* now designated a body of theory, *i.e.* a science as in “zoology” (the knowledge of animals) and “biology” (the science of life)
- Technology then had to be the science of the arts
- In 1706, the *Phillips Dictionary* defines technology as “A Description of Arts, especially Mechanical”.

The History of the Word (2)

- When the first engineering and technical schools were set up in France and Germany in the 18th century, teachers wished for a word to sum up what they taught
- In his 1777 *Anleitung zur Technologie*, German professor Johann Beckmann defined technology as the science that teaches the processing of natural materials or the knowledge of crafts.
- Since nobody has ever agreed on the principles of a general theory of the arts and crafts, “technology” has come to be applied, especially in the English-speaking world, to the productive arts themselves so that a technology can be just about any material process that is either productive (making something new) or practical (manipulating existing things to a useful end)

The History of Technology

- Even before technology was used in the modern sense, historians were interested in the discovery or development of new arts and inventions
- In Antiquity, Pliny the Elder wrote up the first listing of inventions and inventors as Book VII of his *Natural History*
- Later scholars did not seem to realize that newer inventions could be added to the lists until Giovanni Tortelli (1449) and Polydore Vergil (1499)
- The history of technology as merely a history of invention continued to prevail until the 19th century, as encyclopaedias and works by early engineers were dedicated to identifying <u>who</u> had come up with <u>what</u> <u>when</u>

The History of Technology seen by Lewis Mumford (1)

- "*Technics and Civilization* was first published in 1934. At that time, though scholars often characterized the present period as the 'Machine Age' they still looked for its beginnings in the eighteenth century; for A. J. Toynbee, a relative of the present historian, had in the eighties applied the term 'The Industrial Revolution' to the technical innovations that had then taken place. And while anthropologists and archaeologists paid due attention to the technical equipment of primitive peoples, sometimes exaggerating the formative effect of tools, the broader influence of technics upon human cultures was hardly touched on: the useful and the practical still stood outside the realm of the good, the true, and the beautiful."

The History of Technology seen by Lewis Mumford (2)

- "*Technics and Civilization* broke with this traditional neglect of technology: it not merely summarized for the first time the technical history of the last thousand years of Western civilization, but revealed the constant interplay between the social milieu—monasticism, capitalism, science, play, luxury, war—and the more specific achievements of the inventor, the industrialist, and the engineer. While Karl Marx had erroneously assumed that technical forces (the system of production) evolved automatically and determined the character of all other institutions, this new analysis demonstrated that the relationship was reciprocal and many-sided: a child's toy might lead to a new invention, such as the motion picture, or the ancient dream of instant communication at a distance might prompt Morse to invent the electric telegraph."

From Inventions to Networks

- The early history of technology was a history of inventions
- During the 20th century, historians moved to look at more than single innovations
- On the one hand, like Mumford, they started examining the contributions of others, who might not be inventors or innovators as such
- On the other hand, they took into account not just a patented invention but entire systems
- Beyond systems, scholars now consider not only institutions but also alliances and crossovers

Technology and Politics

- Langdon Winner tackles the relationship of technology and politics
- Ever since Plato, it has been claimed that, in certain circumstances, there are no political options but authoritarianism
- It is easy enough to show that some technologies have been bent to overtly political ends
- But is it in the *nature* of certain specific technologies to compel specific social and political options?

"We shape our buildings, and afterwards our buildings shape us."
— Winston Churchill, 28 October 1943

Politics Made Concrete

This 1906 postcard of the Boulevard Montmartre in Paris illustrates the great width of Baron Haussmann's new avenues designed to deter barricades.

Pierre-Auguste Renoir, “*Les grands boulevards”*, 1875

Paris artery on July 13, 1917

Long exposure autochrome picture by Paul Castelnau

Hoover Dam

Yearly average volume of Lake Mead (thousands of acre-feet)