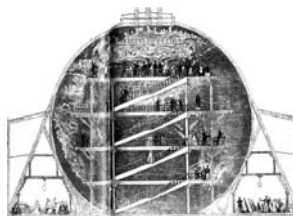


S C I E N C E I N A G L O B A L C O N T E X T
F R O M T H E 1 5 T H T O T H E 2 0 T H C E N T U R Y

Syllabus



PRINCETON UNIVERSITY
HISTORY 293
HISTORY OF SCIENCE
SPRING TERM 2009
MON. & WED. 11:00-12:20
211 DICKINSON



PROFESSOR: D. GRAHAM BURNETT
OFFICE: 205 DICKINSON
MONDAY 12:30-2:30
and by appointment
PHONE: 258-7309
dburnett@princeton.edu

C O U R S E D E S C R I P T I O N :
“ E N C O M P A S S I N G K N O W L E D G E ”

The small inset image above depicts (in cross-section) James Wyld’s “Great Globe,” a five-story hollow sphere constructed in London in 1851 as part of the festivities around the Crystal Palace Exhibition, a vast world’s fair that celebrated British industrial power and global empire. If you look closely, you will see the people lined up for a tour. Inside, visitors blinked, adjusting their eyes to the dark, and found themselves enclosed in a panoramic spherical relief map of the whole earth. They could survey their world, make sense of the entire thing, see the order and arrangement of their planet.

Wyld’s Great Globe suggests a number of the themes in this course, which surveys the history of science in a global context from the Early Modern period up to World War I. First of all, Wyld’s globe is an effort to “encompass” geographical knowledge in the mid-nineteenth century—it is the product of a historical and global process of exploration, astronomy, cartography, and compilation. We will be examining this history in some detail over the semester, learning how European traveling naturalists and surveyors circumnavigated the earth, encountering strange peoples and places, making collections and observations. We will think about how their work contributed to the understanding of nature (human nature, too), and how their activities both depended on, and contributed to, expanding European hegemony. (It is no accident that Wyld’s Globe sat in London, an imperial metropolis—it let Victorians gaze at a globe they thought of as, in significant ways, *theirs*).

The image is evocative in another way too. A well known philosopher of science once wrote that “all theory may be regarded as a kind of map extended over space and time.”* Scientific theories, right or wrong, do seem a little like maps—they “depict” how things are, they make promises, they provide the framework into which new findings must fit. Since this is a course in the history of science, we will be thinking about some of the very different ways that humans have tried to organize and represent (“map”?) their knowledge of nature.

Looking back, then, at the tiny figures inside Wyld’s Globe, we can see that they are quite literally “encompassed” by their map—it is all around them, and so it is all they see. This nicely captures the double meaning of the subtitle of our class, “Encompassing Knowledge”: on the one hand we are studying the history of efforts to “reach around” the whole world for what can be known; at the same time we are interested in understanding how our accounts of nature and our ways of knowing bound what we see of the world.

One last thought: was seeing the Great Globe like seeing the actual earth? In a way. But of course, in another way, it was not like seeing the earth at all: to make it possible to take in the whole world from a single vantage point, all the relief—mountains, valleys, canyons—had to be *inverted*; the earth had to be turned inside out. We might keep this curious fact in mind as we set off to think about science and technology in the history of European expansion and global modernity: Wyld’s Globe suggests that comprehensive visions of the natural world can produce (even demand?) peculiar distortions. The map, as they say, is not the territory. Or is it?

* M. Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy* (London: Routledge & Kegan Paul, 1958), p. 4.

R E Q U I R E M E N T S

There are no precepts for this course, and our twice-weekly meetings will consist of a mixture of lecture and discussion. Readings in the syllabus have been arranged by class session (not by week), and you are expected to have completed the reading for each class before we meet. Attendance will be taken, and participation matters, particularly when you are “on call” to help us think about the material. More on this when we talk the first day.

- Think pieces and discussion 40%
- Midterm exam 20%
- Final exam 30%
- General participation 10%

B O O K S A N D R E A D I N G S

The majority of the reading for the class is to be found in a packet (available at the university bookstore). In general, I am down on packets, since they do not give you a good sense of where the material comes from, and they prevent you from getting a feel for the larger works that have been excerpted. To remedy this I have written a brief introduction to each reading in the packet. This should help you get oriented. There are also five books available for purchase (also at the university bookstore). From two of these we will be reading at length, and I have listed them as required. The assigned sections from the other three appear in the packet; you may buy them if you wish. All five of these books should be on reserve in Firestone, along with a handful of others that have been excerpted in the packet (listed below); you might take a look at these at some point during the term.

Required:

- Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989)
- Charles Darwin, *On the Origin of Species: A Facsimile of the First Edition*, introduction by Ernst Mayr (Cambridge: Harvard University Press, 1964[1859])

Optional:

- Charles Darwin, *Voyage of the Beagle*, ed. Janet Browne and Michael Neve (London: Penguin, 1989[1838])
- Daniel R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (Oxford: Oxford University Press, 1981)
- Lewis Pyenson and Susan Sheets-Pyenson, *Servants of Nature: A History of Scientific Institutions, Enterprises, and Sensibilities* (New York: Norton, 1999)

On Reserve:

- David Goodman and Colin A. Russell, *The Rise of Scientific Europe 1500-1800* (Kent: Hodder and Stoughton, 1991)
- N. Jardine, J.A. Secord, and E.C. Spary, eds., *Cultures of Natural History* (Cambridge: Cambridge University Press, 1996)
- Paul Lawrence Farber, *Finding Order in Nature: The Naturalist Tradition from Linnaeus to E.O. Wilson* (Baltimore: Johns Hopkins, 2000)
- Anthony T. Grafton, *New Worlds, Ancient Texts: The Power of Tradition and the Shock of Discovery* (Cambridge: Harvard University Press, 1992)
- William J.H. Andrewes, ed., *The Quest for Longitude* (Cambridge: Collection of Historical Scientific Instruments at Harvard University, 1996)

Websites:

<http://shot.press.jhu.edu/>
<http://www.hssonline.org/>

Society for the History of Technology
History of Science Society

T O P I C S A N D A S S I G N M E N T S



P A R T I

(Weeks 1 & 2)

N E W W O R L D S A N D N E W I D E A S :
T H E S H O C K O F E A R L Y M O D E R N D I S C O V E R Y

WEEK 1

Class 1 Introduction

Michael J. Crowe, "The History of Science: A Guide for Undergraduates," online at: <http://web.clas.ufl.edu/users/rhatch/pages/02-TeachingResources/crowe/crowe.html> 20*

Class 2 The Age of Discovery and the Scientific Revolution

David Goodman, "Iberian Science," excerpt from Chapter 5 of *The Rise of Scientific Europe 1500-1800* (Kent: Hodder and Stoughton, 1991), pp. 117-127 10

Anthony T. Grafton, "Navigators and Conquerors" and "All Coherence Gone," Chapters 2 and 3 of *New Worlds, Ancient Texts* (Cambridge: Harvard, 1992), pp. 59-157 90

José de Acosta, excerpt from *The Natural and Moral History of the Indies* (1590), edited by C.R. Markham (London: Hakluyt, 1880), pp. 24-29, 89-91, 257-261 10

* Approximate number of pages in each reading in this column

WEEK 2

Class 3 Salomon's House: Francis Bacon and a Utopia of Learning

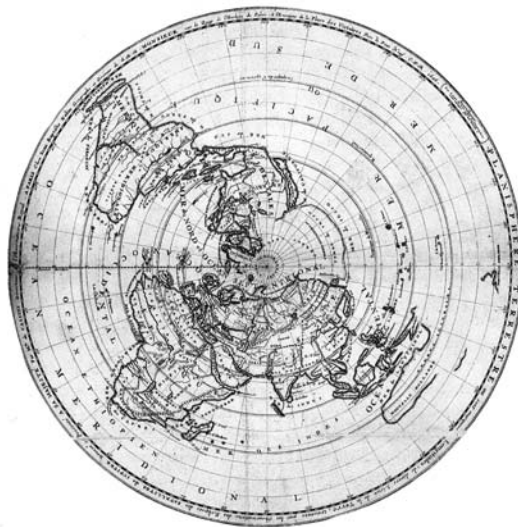
- Francis Bacon, excerpt from the *New Atlantis* (c.1624); reprinted from Kessinger edition 40
- Carolyn Merchant, "Dominion over Nature," Chapter 7 of *The Death of Nature* (New York: Harper & Row, 1980), pp. 164-191 30
- Royal Society, "Directions for Sea-Men, Bound for Far Voyages" from *Philosophical Transactions of the Royal Society*, Volume 1, 1665-1666; reprinted from JSTOR 3

Class 4 The Newtonian Legacy: A Mathematical System of the World

- Isaac Newton, "Author's Preface to the Reader" from the *Principia* (1687); reprinted from *Newton: A Norton Critical Edition*, edited by I.B. Cohen and R.S. Westfall (New York: Norton, 1995), pp. 224-226 2
- Michael S. Mahoney, "Longitude in the Context of the History of Science" from *The Quest for Longitude*, edited by William J.H. Andrewes (Cambridge: Collection of Historical Scientific Instruments at Harvard University, 1996), pp. 64-68 4

General Reading for the Week

- Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989), Chapter 1 45



P A R T I I

(Weeks 3-6)

ENLARGING A SPHERE OF CONTEMPLATION: INVENTORY AND COSMOGRAPHY IN THE ENLIGHTENMENT



WEEK 3

Class 5 Scientific Exploration and Newtonian Controversy: The Earth's Shape

- Mary Louise Pratt, "Science, Planetary Consciousness, Interiors," Chapter 2 of *Imperial Eyes* (London: Routledge, 1992), pp. 15-37 15
- John Noble Wilford, "The Matter of a Degree," Chapter 7 of *The Mapmakers* (New York: Vintage, 1981), pp. 94-110 15
- Pierre Louis Moreau de Maupertuis, excerpt from the "Preface" of *The Figure of the Earth, Determined from Observations made by Order of the French King at the Polar Circle... from the French* (London: T. Cox, 1738), pp. 1-15 15

Class 6 The System of Nature: Taxonomy and Global Inventory

- Paul Lawrence Farber, "Collecting, Classifying, and Interpreting Nature: Linnaeus and Buffon, 1735-1788," Chapter 1 of *Finding Order in Nature* (Baltimore: Johns Hopkins, 2000), pp. 6-21 15
- Carolus Linnaeus (Carl Von Linné), *Systema Naturae* (1735); reprinted from the translation and facsimile edition prepared by M.S.J. Engel-Ledeboer and H. Engel (Nieuwkoop: B. De Graaf, 1964), pp. 17-30 15

General Reading for the Week

- Jonathan Swift, "Voyage to Laputa, etc.," Part III of *Gulliver's Travels* (1726); reprinted from *Gulliver's Travels: A Norton Critical Edition*, edited by R.A. Greenberg (New York: Norton, 1980), pp. 126-187 60

WEEK 4

Class 7 Celestial Metrics in the South Seas: The Transits of Venus

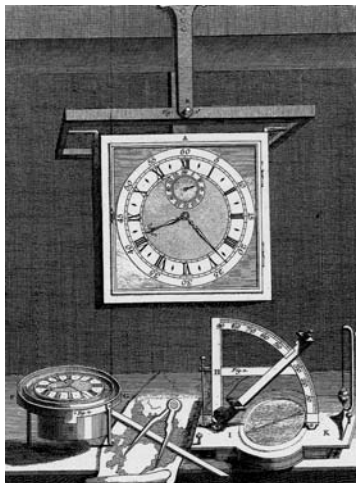
- Christopher Lloyd, "Introduction," from *The Voyages of Captain Cook* (London: Cresset, 1949), pp. xi-xxii 10
- Derek Howse, "Navigation and Astronomy in the Voyages," Chapter 5 of *Background to Discovery* (Berkeley: University of California, 1990), pp. 160-184 25
- James Cook, excerpt from his "Endeavour Journal," April to June of 1769, from *The Journals of Captain James Cook on his Voyages of Discovery*, edited by J.C. Beaglehole (London: Hakluyt Society, 1954), pp. 74-98 25

Class 8 Chronometrics and Geodetics: Solving the Longitude Problem

- David S. Landes, "The Man Who Stayed to Dinner," Chapter 9 of *Revolution in Time: Clocks and the Making of the Modern World* (Cambridge: Harvard, 1983), pp. 145-157 10

General Reading for the Week

- Lewis Pyenson and Susan Sheets-Pyenson, "Travelling: Discovery, Maps, and Scientific Exploration," Chapter 9 of *Servants of Nature* (New York: Norton, 1999), pp. 236-263 30
- Marie-Noëlle Bourguet, "The Explorer," Chapter 7 of *Enlightenment Portraits*, edited by Michael Vovelle (Chicago: University of Chicago, 1997), pp. 257-315 55



WEEK 5

Class 9 Natural Knowledge and the Right to Rule: Banks and Networks of Empire

- David Mackay, "Introduction: Exploration, Science and Empire in the late Eighteenth Century," Chapter 1 of *In the Wake of Cook* (London: Croom Helm, 1985), pp. 3-27 25

Class 10 A Great Map of Mankind: Conjectural Histories and Remote Peoples

- Denis Diderot, *Supplément au Voyage de Bougainville* (1773); reprinted from *Denis Diderot: Political Writings*, edited by J.H. Mason and R. Wokler (Cambridge: Cambridge University Press, 1992), pp. 31-75 40

General Reading for the Week

- Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989), Chapter 2 70



WEEK 6

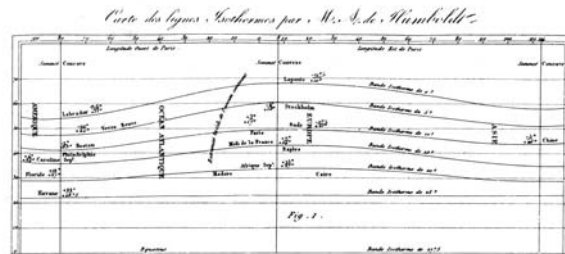
Class 11 Progress, Revolution, Conquest: French Science and Civilization

- Antoine-Nicolas de Condorcet, "Stage Nine: From Descartes to the Foundation of the French Republic," and "Stage Ten: The Future Progress of the Human Mind," Chapters 9 and 10 from *Sketch for a Historical Picture of the Progress of the Human Mind* (1795); reprinted (with the introduction) from the edition translated by J. Barraclough and edited by S. Hampshire (London: Weidenfeld and Nicolson, 1955), pp. vii-xii, 125-202 80
- Charles C. Gillispie, "The Scientific Importance of Napoleon's Egyptian Campaign," *Scientific American*, September, 1994, 27(3):78-85 25
- Al-Jabarti, excerpts from a *Chronicle of the French Occupation of Egypt* (the *Tārīkh muddat al-Faransīs bi Miṣr* [1798]); Louis Antoine Fauvelet de Bourienne, excerpts from *Memoirs of Napoleon Bonaparte* (1829); both texts reprinted from *Napoleon in Egypt*, translated by S. Moreh and edited by R.L. Tignor (New York: Markus Wiener, 1993), pp. 106-111, 153-159 10

Class 12

MIDTERM

P A R T I I I
(Weeks 7-9)
E M E R G I N G O R D E R S :
G L O B A L K N O W L E D G E F R O M H U M B O L D T T O
D A R W I N



WEEK 7

Class 13 The Geography of Inventory: Humboldt and the Physics of Nature

- Mary Louise Pratt, introductory excerpt from “Alexander Von Humboldt and the Reinvention of América,” Chapter 6 of *Imperial Eyes* (London: Routledge, 1992), pp. 115-119 4
- Susan Faye Cannon, “Humboldtian Science,” Chapter 3 of *Science in Culture* (New York: Dawson, 1978), pp. 73-110 35
- Alexander von Humboldt, “Translator’s preface,” “Author’s introduction,” “List of instruments,” from *Personal Narrative of Travels to the Equinoctial Regions of the New Continent during the years 1799-1804*, translated by Helen Maria Williams (London: Longman, 1814-29), pp. i-xii, i-li, 34-40 70

Class 14 Analysis and Comparison: The Museological Moment

- Paul Lawrence Farber, “New Specimens” and “Comparing Structure,” Chapters 2 and 3 of *Finding Order in Nature* (Baltimore: Johns Hopkins, 2000), pp. 22-45 25
- Dorinda Outram, “New spaces in natural history,” Chapter 15 of *Cultures of Natural History*, edited by N. Jardine, J.A. Secord, and E.C. Spary (Cambridge: Cambridge University Press, 1996), pp. 249-265 20



WEEK 8

Class 15 The Strata of the Earth: Geology and Deep Time

- Martin J. S. Rudwick, "Minerals, strata, and fossils," Chapter 16 of *Cultures of Natural History*, edited by N. Jardine, J.A. Secord, and E.C. Spary (Cambridge: Cambridge University Press, 1996), pp. 266-286 20
- Robert A. Stafford, "Annexing the landscapes of the past: British imperial geology in the nineteenth century," Chapter 4 of *Imperialism and the Natural World*, edited by John M. MacKenzie (Manchester: Manchester University Press, 1990), pp. 67-89 20
- Georges Cuvier, excerpt from the "Preliminary Discourse" of *Recherches sur les Ossimens Fossiles de Quadrupèdes* (1812); reproduced from *Georges Cuvier, Fossil Bones, and Geological Catastrophes*, edited and translated by Martin J. S. Rudwick (Chicago: University of Chicago, 1997), pp. 183-193 10
- Charles Lyell, Table of Contents and Chapter 1 of *Principles of Geology* (London: John Murray, 1830), pp. v-xv, 1-4 10

Class 16 Charles Darwin and the Voyage: From Student to Naturalist

- Charles Darwin, "Voyage of the Beagle," excerpt from *The Autobiography of Charles Darwin*, edited by Nora Barlow (New York: Norton, 1993), pp. 71-85 15
- James A. Secord, "The discovery of a vocation: Darwin's early geology," *British Journal for the History of Science* 1991 (24):133-57 25
- Charles Darwin, "Galapagos Archipelago," Chapter XIX of *Voyage of the Beagle* (1839); reprinted from the Penguin Classic edition, edited by Janet Brown and Michael Neve (New York: Penguin, 1989), pp. 268-290 20

General Reading for the Week:

- Charles Darwin, *On the Origin of Species* (1859), facsimile of the first edition (Cambridge: Harvard, 1964), Darwin's Introduction and Chapter 1 40

N.B. Next week we focus on the Origin, but there is a good deal to get through, so try to get started.

WEEK 9

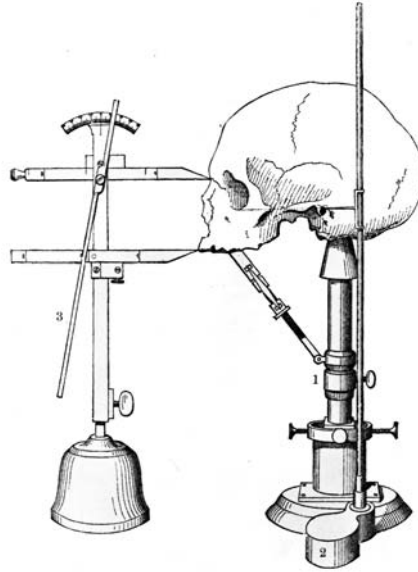
Class 17 The Origin: Text and Context

- Charles Darwin, *On the Origin of Species* (1859), facsimile of the first edition (Cambridge: Harvard, 1964), continue through Chapter 4 100

Class 18 The Origin Continued: Reception and Legacy

- Charles Darwin, *On the Origin of Species* (1859), facsimile of the first edition (Cambridge: Harvard, 1964), Chapter 6, excerpt from Chapter 10 (pp. 312-336), excerpt from Chapter 11 (pp. 346-365), and Chapter 14 90

P A R T I V
(Weeks 10-12)
C I V I L I Z I N G M I S S I O N S :
S C I E N C E , T E C H N O L O G Y , A N D M O D E R N I T Y



WEEK 10

Class 19 New Sciences of the Human: Race, Anthropology, Empire

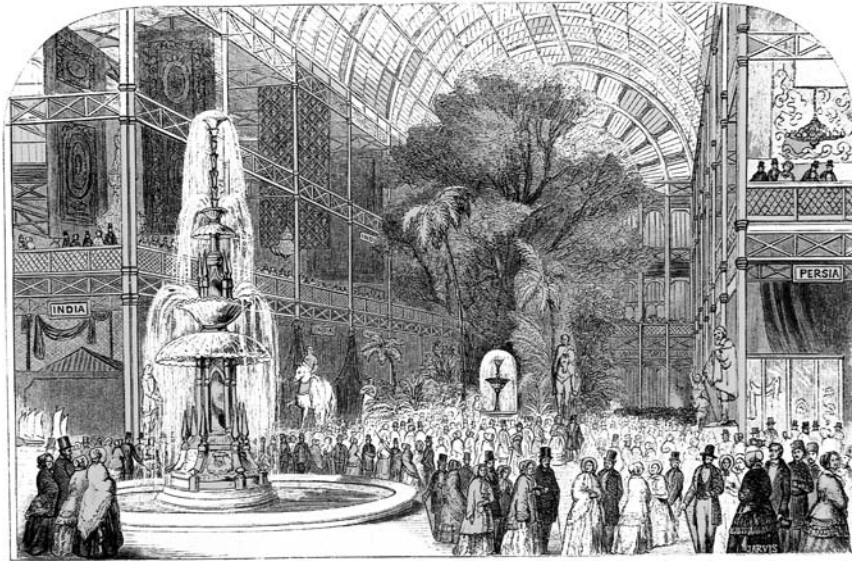
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| Daniel Kevles, "Francis Galton, Founder of the Faith," Chapter 1 of <i>In the Name of Eugenics</i> (Cambridge: Harvard, 1995), pp. 3-19 | 15 |
| Francis Galton, excerpts from "Heredity" and "Race Improvement," Chapters 20 and 21 of <i>Memories of My Life</i> (London: Methuen, 1909), pp. 287-294, 310-323 | 15 |
| Francis Galton, "Classification of Men According to Their Natural Gifts" (excerpt) and "The Comparative Worth of Different Races," Chapters 3 and 20 of <i>Hereditary Genius</i> (London: Macmillan, 1869), pp. 34-36, 336-350 | 15 |

Class 20 Exhibition and Industry: A World on Display

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| Robert Brain, "Introduction," from <i>Going to the Fair: Readings in the Culture of Nineteenth-Century Exhibitions</i> (Cambridge: Whipple Museum, 1993), pp. 9-14 | 5 |
| William Whewell, "The General Bearing of the Great Exhibition on the Progress of Art and Science," from <i>Lectures on the Results of the Exhibition</i> (London: Bogue, 1852), pp. 3-25 | 25 |

General Reading for the Week

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| Michael Adas, <i>Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance</i> (Ithaca: Cornell University Press, 1989), Chapter 3 | 70 |
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WEEK 11

Class 21 The Tools of Empire: Weapons, Trains, Telegraphs

Daniel R. Headrick, "The Tools of Imperialism: Technology and the Expansion of European Colonial Empires in the Nineteenth Century," *The Journal of Modern History*, June, 1979, 51(2):231-263 30

Rudyard Kipling, "The Bridge-Builders" (1898); reproduced from *Rudyard Kipling*, edited by D. Karlin (Oxford: Oxford University Press, 1999), pp. 163-190 30

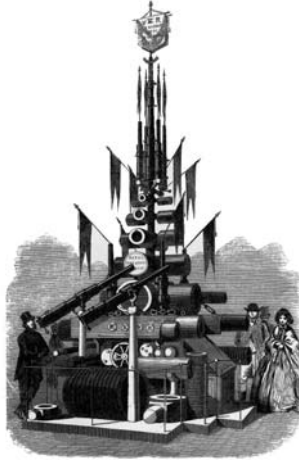
Class 22 Medicine in the Tropics: Disease, Climate, Bacteriology

David Arnold, "Medicine and Colonialism," Chapter 58 (Volume 2) of *Companion Encyclopedia of the History of Medicine*, edited by W.F. Bynum and R. Porter (London: Routledge, 1993), pp. 1393-1416 25

General Reading for the Week

Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989), Chapter 4 70





WEEK 12

Class 23 Science, Nationalism, Modernity

Alfred Russel Wallace, "Estimate of Achievements:—The Nineteenth Century as Compared with Earlier Centuries" and "The Plunder of the Earth—Conclusion," Chapters 15 and 21 of *The Wonderful Century* (London: Swan Sonnenschein, 1898), pp. 150-156, 367-379 15

George Basalla, "The Spread of Western Science," *Science*, May 5, 1967, 156(3775):611-622 10

Class 24 Review and Conclusion

Jules Verne, "Eternal Adam" (1905), translated by Willis T. Bradley; reproduced from *Masterpieces of Science Fiction*, edited by Sam Moskowitz (Cleveland: World Publishing, 1967), pp. 168-206 35

General Reading for the Week

Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989), Chapter 6 70



E N D O F T E R M