

American Economic Development, Science, Higher Education, and UC Berkeley

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Purpose of Talk

- Highlight the relationship between economic development, the growth of scientific knowledge and the rise of the higher education system in the United States
- Discuss this relationship from the first settlers to the present
- Suggest the form of higher education follows the peculiarities of US development and ideas
- Discuss the relationship of UC Berkeley to this

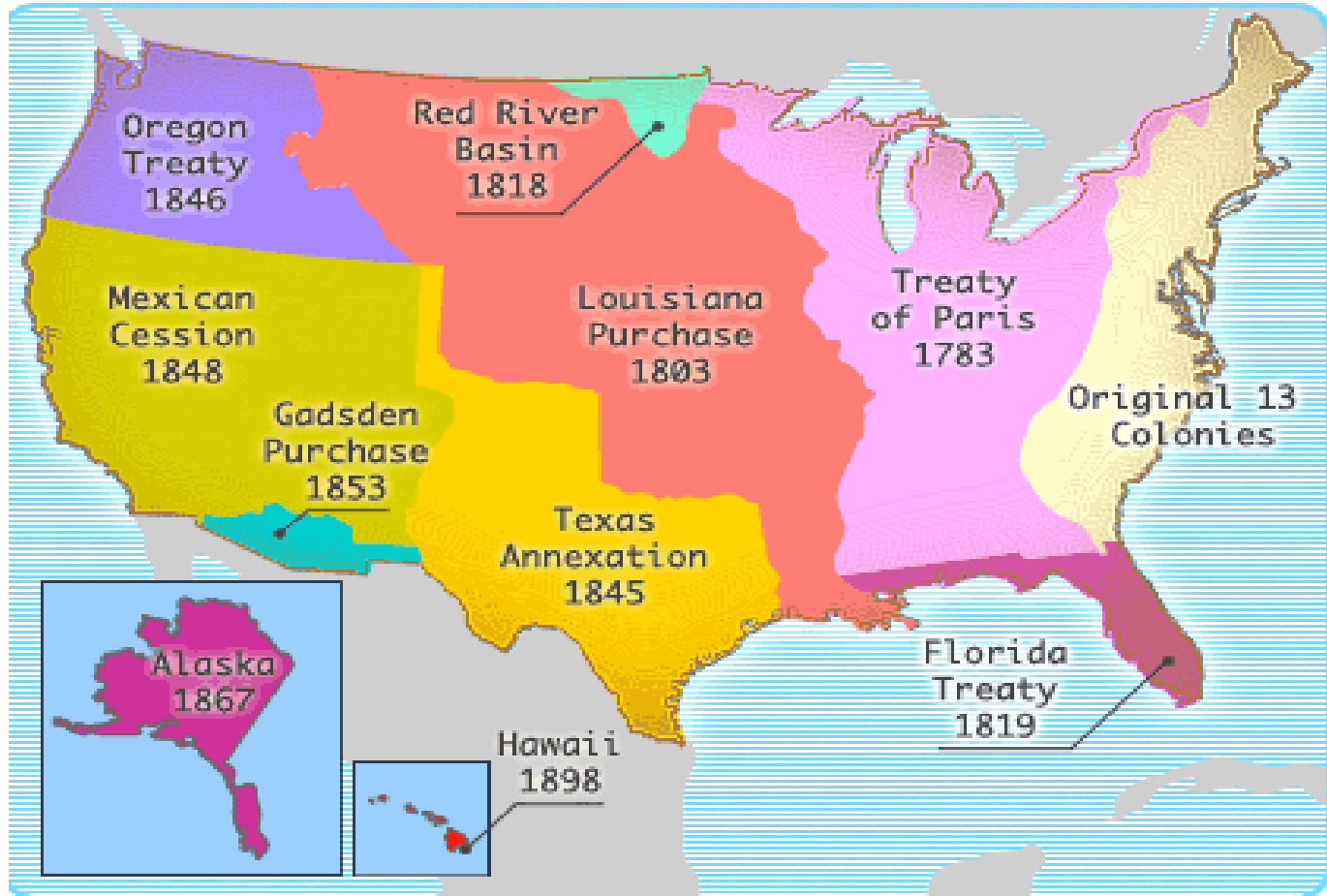
Definition of Terms

- Economic Development: The cumulative growth in productive value leading to economic diversification, improved standard of living, surplus wealth: related to
- Improving technology; accumulated scientific knowledge: distinct from
- Industrialization: substitution of machines for animal or human labor; great increase in production

Periodization of Overview

- **First 200 Years**
- **Independence**
- **Consolidation of American Science and Education, to 1861**
- **Creation of the first Universities**
- **From World War I to end of World War II**
- **Post World War II to Present**

Expansion of the United States 1776-1898



– Source: Interactives: United States History Map <http://www.learner.org/interactives/historymap/states.html>

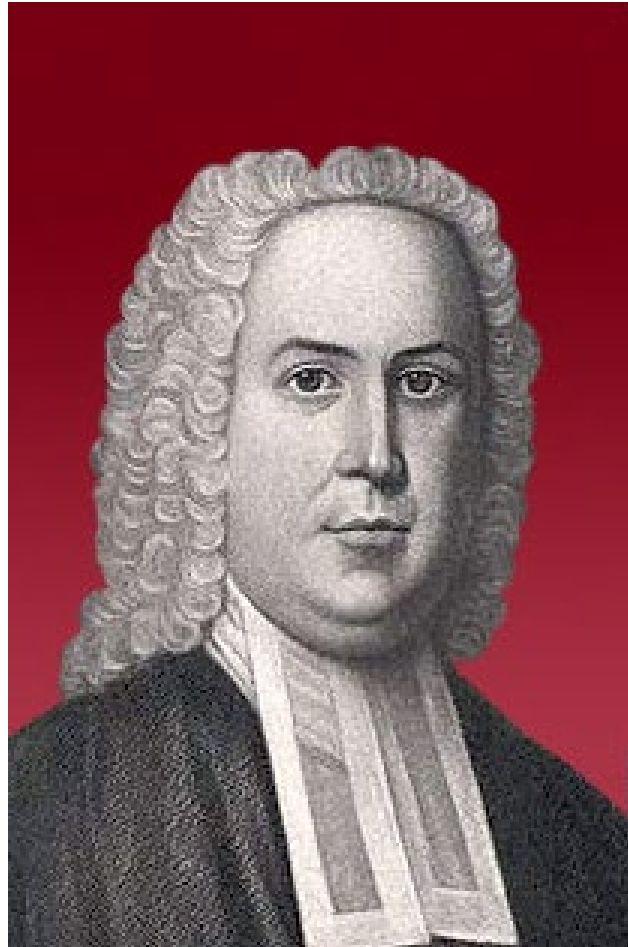
First 200 Years

- Settlement:
 - English colonies in “Virginia” 1584, 1607 founding of Jamestown, 1612 tobacco
 - “New England” 1620 Pilgrims on Mayflower with MA s
 - Settlement leaders well educated, big difference between aristocrats in Virginia and Puritans in Massachusetts in outlook

Growth of Education

- 1638 Harvard College founded. College of William and Mary in 1693. Total 12 colleges by 1776
- 1756 College of Philadelphia focuses on science and applied subjects
- 1766 6 of 8 colonial colleges had professorships in Mathematics and Natural Philosophy

Charles Chauncy, M.A. President of Harvard University 1654-72 and Fellow of Trinity College Cambridge



Source: <http://www.harvard.edu/history/presidents/chauncy>

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The Reverend Dr. James Blair College of William and Mary First President



Source: http://en.wikipedia.org/wiki/James_Blair_%28Virginia%29

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William Fitzhugh 1697

Virginia Historical Society (www.vahistorical.org)

Economy



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Economic Situation

- Colonies prosper through trade, shipbuilding, artisan production
- Small manufactories using European technology
- Lucrative trade among British colonies in sugar, rum, natural products
- More lucrative trade in slaves, plantation system established

From Independence in 1776

- Economic, tax disputes, religious contention promote dissatisfaction
- July 4, 1776 Declaration of Independence
- 1789 First Congress, April George Washington 1st president
- 1802 17 states
- 1803 Louisiana Purchase 80 million francs
- 1812 War with Britain-1814 Treaty of Ghent

Economic Technical Situation

- 1791 intro of mechanical spinning machine (Arkwright journeyman-stolen)
- 1793 Eli Whitney invents the cotton gin
- Trade reduced through European wars
- Opportunity through the Louisiana Purchase 1802 (\$15,000,000)
- 1807 first steamboat

Consolidation of American Science and Education, to 1861

- 1802 West Point founded to train military engineers, surveyors
- 1824 Rensselaer Institute—1st labs in chemistry, physics
- 1828 First steam railway-13 miles, vs. 3,326 miles of canals
- 1832 Oberlin College founded and admit women
- 1848 California joins the Union, gold rush

Growth of Colleges

Laying the foundation for an ideal type

Ministers go west founding small liberal arts colleges. Up to 700 tried and failed to 1860, BUT 380 survived

“Emory college in Georgia (1838) was opened on the strength of the unpaid interest on what were still unpaid pledges.”

(Rudolf, p.46)

Characteristics of the New College

- Small, located in relative wilderness, provided all services needed by students (housing, dining, health care, religious instruction, in loco parentis model).
- Introduction of competitive sports, relative isolation and small numbers led to strong college loyalties—alumni associations
- Colleges for both men and women,

Parallel Growth of Science

- 1800 most colleges had a science prof
- 1860 most had four
- 1854-60 Sheffield Scientific School at Yale
- 1857 Lawrence Scientific School at Harvard
- Science training and much scientific discovery still occurs in Europe both in and out of universities

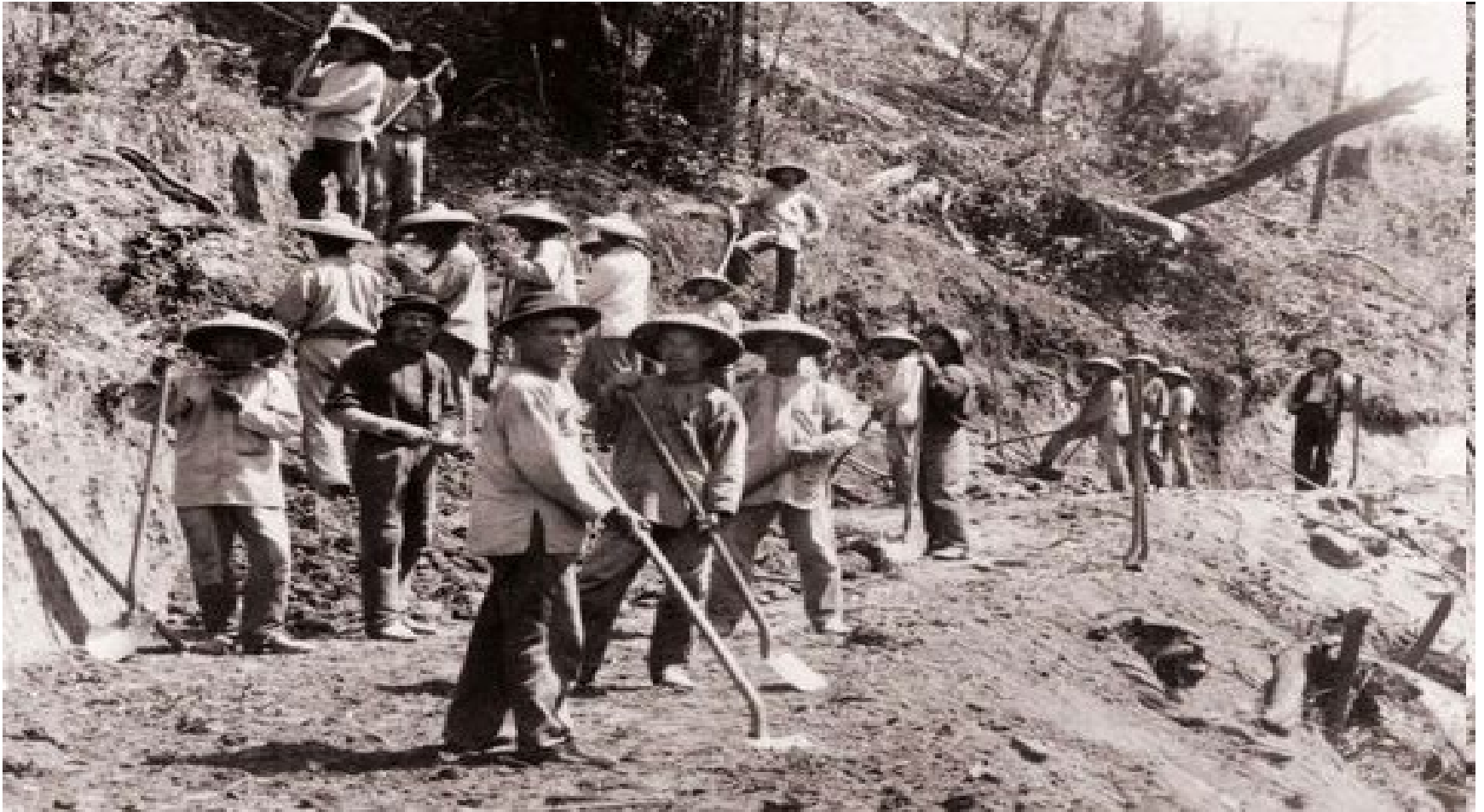
Civil War and Beyond- Creation of the first Universities

- 1861 Yale awards first Ph.D.s
- 1862 Morrill Land Grant Act
- 1863-69 Completion of first Transcontinental Railroad
- 1861-65 Vassar College for Women founded with science curriculum, Ph.D. faculty
- 1865-1917 Rise of big capital, “robber barons” huge growth in national wealth

Economic Growth

- After Civil War transportation expansion, transcontinental railroad, steamships,--based on new technology
- Monopolies, trusts, ruthless exploitation, range wars, (raw materials) particularly in oil (Standard Oil), mining (gold, silver, copper, iron, coal), processing (steel, Carnegie)
- Communications: AT&T, power, water

Chinese Laborers on Transcontinental Railroad



Source: <http://asianamerican1.blogspot.com/2010/11/chinese-immigrants-and-transcontinental.html>

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California

- Territory taken from Mexico, rapidly wealthy, 1849 legislature in Vallejo
- 1868 University of California chartered as Land Grant University
- 1869 First students, 1870 first women students
- 1873 First graduating class See: <http://berkeley.edu/about/hist/index.shtml>
- 1884 First B. Ph.D. award in Chemistry at University of California
- 1900 Berkeley has 1,988 students enrolled

California Exploited

- Agriculture
- Railways Leland D. Stanford, RR King
- Water and Power
- Minerals
- Shipping
- Banking
- Commerce

Leland D. Stanford



Source: http://en.wikipedia.org/wiki/Leland_Stanford

Philanthropic After Effects

- Johns Hopkins 1876
- Stanford University 1891
- University of Chicago, 1890 John D. Rockefeller
- Vanderbilt 1873 Cornelius Vanderbilt
- Berkeley profits too . . .

The Beginning of the 20th Century

- Founding of the American Association of Universities 1900, California one of the five conveners
- Shaped the future of graduate education and became the standard for national and international evaluation
- Foundation of Carnegie Foundation in 1906 assisted by setting undergraduate admission standards
- Major disciplinary associations founded, with own journals, A Historical A, A Mathematical S.

From World War I to End of World War II

- 1920s enrollment in U.S. reaches a high point, especially for women
- 1930s period of extensive scientific work in physics, chemistry, mathematics
- Berkeley site of intensive scientific research, Ernest O. Lawrence designs first cyclotron
- 1930s—1945 U.S. government organizes scientists for war effort. Atom bomb
- 1941 Glenn T. Seaborg and Edwin McMillan produce plutonium

Period to WW II in US

- Expansion of undergrad enrollment in 1920s, Ph.D.s increase 274% to 1930
- Women growing in number and percent both as students and faculty
- Landgrant institutions consolidate, formalized graduate programs, build facilities
- Gains in momentum undone by Great Depression, enrollment drops at all levels

Post World War II to Present

- U.S. government sponsors and pays for scientific research at universities,
- 1957 Soviet Union launches Sputnik, U.S. national investment grows at all levels
- Research universities and Ph.D. programs grow
- Expansion of U.S. higher education: 2008 total student enrollment at 4 yr. 9,394,633
- 6,971,105 at 2 yr. colleges

Summary of US Graduate System 2010

- Total enrollment in all graduate programs:
 - 1.75 million, 59% women
 - 445,000 new enrollees 2010 – 84% seeking MA s
 - 611,600 total enrollment in science and engineering
 - 2009 (Sources: Council of Graduate Schools, NSF S&E Degrees)

Total college enrollment 2010: 20,550, 000

70% high school finishers enroll in college

(Source: National Center for Education Statistics, US Census)

Summary of US System of Doctoral Education 2010

- 418 Doctoral granting institutions (ca. 6,000)
- 48,069 Doctorates all fields, 46.8% female
 - US citizen/permanent resident 31,573 (52% Fe)
 - Temporary visa holders 13,625 (36% Female)
 - Unknown citizen ship 2,855

Bio/biomedical sciences US/PR: 5,577, Int'l: 2,083 (26%)

Physical Sciences US/PR: 4,256, Int'l: 3,351 (40%)

Engineering US/PR: 3,303, Int'l: 3,851 (51%)

(Source: NSF/NIH/USED/USDA/NEH/NASA, 2010 Survey of Earned Doctorates)

Characteristics of US Higher Education Today

- A type of institution for every need—non-profit, for-profit, 2 year, 4 year, professional school, doctoral research university
- No national system, but independent growth of institutions, not national or state ministries
- Quality control developed by institutions themselves
- Developed in ad hoc manner, a form of entrepreneurship

Characteristics Continued

- Participation increasingly determined by social class
- Flagging public support for both higher education and science
- Persistent hostility to intellectuals, higher education, basic tenants of science including evolution and climate change

Conclusion

- The rise of colleges and universities in US directly related to:
 - European ideas about education modified for US circumstances
 - Required wealth to create and sustain
 - Sources of wealth from federal and state governments,
 - Private donors extremely important
 - Inter related with the development of big science and applied technology