

Midterm - INTD262

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1 Unit 0

1. Offer some reasons why the Spaniards created the virreynatos of Nueva España and Perú in their respective locations, with Tenochtitlan and Lima as capital cities.

Nueva España (former Aztec empire) and Peru (former Inca empire) were formed by these civilizations because natural resources and tools were already established. Tenochtitlan had a large lake surrounding which offered water.

2. Was there a link between the introduction of capitalism and the growth of scientific activity in Latin America, or did the growth of modern science precede capitalism?

The growth of science definitively was influenced by capitalism (funding expeditions etc) however there needs to be an understanding that science came before capitalism in Latin America.

- * 3. Given the definition of peripheral scientific activity in the Introduction, can you give an example of the creating and transmission of scientific results from the periphery to the center of science?

The idea of malaria may work in terms as it is an outside problem that inspired/demanded a solution. peripheral science activity is the ideas of accurate discovery.

4. Give some examples of pseudo-scientific beliefs regarding mythical places the colonials sought in the New World.

some examples of pseudo science include:
- The lost city of gold = Eldorado - Aliens
- Fountain of Youth

5. Multiple Choice - Nahua scientific activity, first period

- (a) Which of the following were media through which inhabitants of the Mexica empire recorded scientific observations about the natural world?

- A: Azolotl (codices) and huitzitzilin (paintings, stelae)
- **B: Amoztl (codices) and tlacuicoll (paintings, stelae)**
- C: Tomatl (plume, writing tool) and altepetl (city-state)
- D: Quetzal (plume, writing tool) and huitzitzilin (city-state)

- (b) Using information from *Historia natural y moral de las Indias* (de Acosta), *Historia general y natural de las Indias* (Oviedo), *Décadas del Nuevo Mundo* (Anglería), *Historia de Nueva España* (Hernández), match the European story to the indigenous story or piece of knowledge.

- (1): Ponce de León and the Fountain of Youth
- (2): Griffins so large they capture people and calves as prey, with feathers as large as an arm.
- (3): "A fountain running with hot water and as the water runs it turns to stone."
- (4): "fish that as they leave the water turn into butterflies."
- (5): "...a monstrous animal, with the face of a fox, a tail of a cercopithecus, ears of a bat, human hands, and feet of a monkey." Carries young on the belly.

④ • A: A flying fish

② • B: A condor

③ • C: A mercury mine

① • D: The belief about a certain river among the Lucayo and Carib indigenous

⑤ • E: The Mexican opossum

6. Nahua scientific activity, second period

- (a) Father Bernardino de Sahagún translates from Nahuatl a description of a "tiger" that the indigenous say can do the following: (a) see small things even though there is fog or darkness (b) creates sounds "through the air" to intimidate hunters. What does this writing tell us about the Nahua understanding of physics?

Tell us that they have a certain understanding of animal traits, and environment (fog/darkness). They understood sound and what it was useful for along with the ideas of vision and optics and their importance for

- (b) Why did the Spaniards and Aztec believe that hummingbirds were connected to immortality? hummingbirds not only adapted aerostatically but the Spaniards & Aztecs believed they were like a phoenix because they would hibernate (die) and come back to life.

7. Suppose the following statement is given: "If someone was born between 1945 and 1991, then they have Strontium-90 in their bones." Which of the following statements is deductively valid? (general idea + make conclusion)

- Adam was born in 1963. Therefore, Adam has Strontium-90 in his bones. **deductively valid**
- Eve has Strontium-90 in her bones. Therefore, Eve was born between 1945 and 1991.

8. Consider the following passage from Chapter 1 of *The Scientific Attitude*:

In 1981, the state of Arkansas passed Act 590 which required that public school teachers give "balanced treatment" to "creation science" and "evolution science" in the biology classroom. It is clear from the act that religious reasons were not to be offered as support for the truth of creation science, for this would violate federal law. Instead, the curriculum was expected to concentrate only on the "scientific evidence" for creation science. But was there any? And, how precisely was creation science different from creationism?

Explain the arguments used in court to thwart Act 590 the following year.

creation science was idea of making the creationism more scientific. creationism is the idea that god created all, there wasn't any evidence of god going against the bible. fossils found billion years ago could have been created by god. therefore creation science wanted to be a contender of ideas with the evolution science from Darwin. so there wasn't NOT any evidence against creation science because of the puzzle-solving within an accepted framework and revolution triggered by unavoidable experimental anomalies. (a) Give one example of a scientific revolution, and note the anomaly. (b) Do you think that the colonization of Nueva España triggered a scientific revolution?

a) An example of a scientific revolution was that the sun orbited the earth. The anomaly (away from current thought) is that the data was not explained by the current framework Ptolemaic system earth was center of universe.

b) yes, because 2 different cultures coming together & learning from each others biology & environment gives a different perspective.

10. Fill in Tab. 1 below, using Fig. 1.

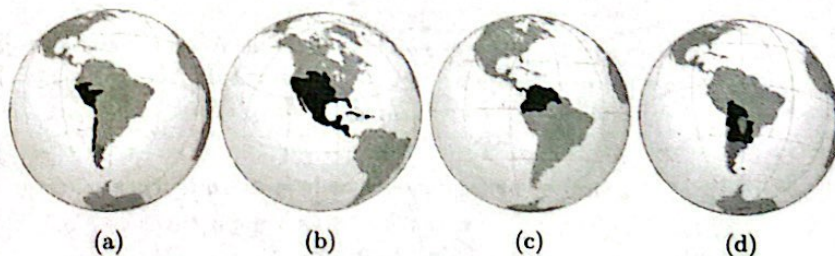


Figure 1: Maps depicting virreinos in Latin America, 17th and 18th centuries.

Map in Fig. 1 (a-d)	Virreinato	Capital
b	Nueva España	México
c	Nueva Granada	Bogotá
d	Río de la Plata	Buenos Aires
a	Perú	Lima

Table 1: Fill in the missing information

11. Consider the library of José Ignacio Bartolache. (a) What does the distribution of texts in this library tell us about the scientific attitude of Latin Americans in the 18th Century? (b) What other scientific items did Bartolache own, and what clues does this add to our picture of the scientific attitude in that time and place? (c) Considering these collections were built before 1760, draw a comparison to the state of science in the American colonies (later the United States).

a) The distribution of texts tells us that in Latin America many different languages were understood/studied in order to read scientific texts that were exported to Latin America. There were texts in French, English, Greek, Hebrew, Nahuatl. The array of subjects were medicine, physics, mathematics, geology, botany, etc.

2 Unit 1

b) we owned telescopes, some scientific tools

c) science was not yet advanced/fully welcomed into Latin

1. In Chapter 2 of *The Scientific Attitude*, we encounter the following quote: America at the time due to the

church controlling education
Samir Okasha recounts the example of John Couch Adams and Urbain Le Verrier ... they were working (independently) within the Newtonian paradigm and noticed a slight perturbation in the orbit of the planet Uranus.

(they were wrong)

Newton's Law of Gravity predicts perfectly elliptical orbits for the planets, with no perturbations. Was the law of gravity therefore falsified? What solved the problem in the end?

The law of gravity was not in fact falsified due to men whose perturbations in the planet Uranus indicating presence of another planet (Neptune)

2. Bode's Law was an attempted mathematical explanation of the planetary orbits. Bode's sequence was the pattern 0, 3, 6, 12, 24, ..., plus 4 to each, then divide the sequence by 10. The result is 0.4, 0.7, 1.0, 1.6, 2.8, 5.2, 10.0, 19.6, 38.8, 77.2, At the time (1772), the radii of the planets from the Sun were 0.387, 0.723, 1.0, 1.524, 5.203, 9.539. Nine years later, Uranus was discovered at 19.18. Twenty years later, the asteroid belt between Mars and Jupiter was discovered at 2.77. Did Bode's Law become a scientific fact because it fit the data?

Bode's law did not in fact become scientific as it just was a mathematical pattern that was created. The discovery of Neptune ultimately broke the law/pattern.

3. In 1761, Judge Francisco Javier Gamboa created a set of legal and scientific studies that were meant to reform the mining industry, to make it more efficient. Recall some scientific results that he shared within his Comentarios a las ordenanzas de minas. What chemicometallurgical technique, important for ore extraction, did he share with The Crown? What institutions did he suggest creating?

The results were using mercury in mining minerals in order to extract the ore. The patio process was created - which got silver out of ores. He also created schools for mining more efficiently.

4. El Real Seminario de Minería was created by Joaquín Velázquez de León, Fausto de Elhúyar, and others. However, several factors might have driven it to bankruptcy. Describe the Mexican efforts to preserve it.

The bankruptcy of El Real Seminario de Minería occurred due to the crown not being involved (not funding/supporting), and professors building the schools but also being miners themselves. To not be bankrupt they needed people to support science by miners supporting schools & producing scientific journals/works.

5. What are the two tenets of the scientific attitude, or ethos, according to the author of *The Scientific Attitude*?

That we care about empirical evidence and that we are willing to change our theory based on evidence.

6. Recall the story of Ignaz Semmelweis and antiseptic handwashing in maternity wards. Discuss how the scientific attitude was applied in this situation.

The original theory is that women were dying childbed fever, but after studies were conducted between 1841 & 1842 new evidence was presenting suggesting the (new theory) theory of germs & cross contamination of tools.

7. Recall the story of the false discovery of cold fusion. (a) Discuss how the scientific attitude was not applied in this situation. (b) Now select a piece of science from Latin American history that we have encountered thus far, and apply the criteria of the scientific attitude to it.

a) the scientific attitude was not applied because they were not willing to change their theory and their data wasn't falsifiable.

b) looking for medical purposes - were ultimately cause other issues (some evidence/theories not willing to be falsified/changed at time).

3 Unit 2

- (a) In what vicerealty (Fig. 1) was the city of Santa Fe de Bogotá? (b) Discuss the scientific implications of the "half century-long polemic on Copernican theories, which started in 1773 between José Celestino Mutis and the Dominican Congregation of Santa Fe de Bogotá. (c) In 1783, the Expedición Botánica began in Santa Fe. What were some of its goals and achievements?

a) Nueva Granada (now Colombia)

b) Copernican theory was we have a Heliocentric solar system (earth is not flat). They believed that the teachings of these theory & calculus & physics would take away from religion

c) latitude and longitude calculations / measurements were made allowing for trade, borders, & cartography

- (a) In what vicerealty (Fig. 1) was the city of Caracas? (b) In 1767, the Jesuit order was expelled from the Spanish colonies. The Dominican order recovered authority over some colleges and universities. What was the implication for science?

a) Nueva Granada (Venezuela)

The Jesuits were society of Jesus. They controlled all of education when they were established. After getting kicked out the Dominicans took the land & for education & political control.

- What scientific publication was created by José Celestino Mutis?

The scientific publication was Botánica Explanación, Politics, and enlightenment ideas. (lead the Spanish revolution & then in independence).

- Evaluate the logical truth of this claim: "anti-vaccination campaigns do not have the scientific attitude, therefore these are not scientific endeavors."

The anti-vaccination campaigns are not classified as scientific attitude because there is no empirical evidence and no willingness to change theories.

- Discuss one example we have encountered from our scientific history that should count as science, even though it has not traditionally been considered scientific.

- hummingbird classification (different words for hummingbirds) they all look similar and have similar properties however it's not taught as scientific even though the origin of the word is evolution.

- different medicine from the names and treatments (new evidence + evaluating theory)

- In Chapter 3 of *Science in Latin America*, we encounter the following quote:

La Universidad Gregoriana in Quito alone had "seventy-one foreign professors teaching at the university ... Native professors were twenty-one, of whom five were from Loja, four from Quito, three from Guayas, three from Cuenca, three from Riobamba, two from Ibarra, and one from Ambato." ... As a consequence, it is not strange that in a center of cultural ferment such as Quito, intellectual Jesuits were most closely linked to the Franco-Spanish geodetic mission directed by La Condamine and Jorge Juan.

- What scientific transition began to take place as a result of the interaction between foreign and Ecuadorian professors? (b) What can we infer about the ratio of the native professors at the university? (c) Consider Father Francisco Javier Aguilar, who taught physics and mathematics at Universidad Gregoriana. He taught no less than five world systems, and focused on three: Ptolemaic, Copernican, and Tychonic. What distinguished these?

a) the exchanging of ideas and cultures 1803 enlightenment thought debated?
b) the ratio of native professors were much smaller 1783-1803 0/10 was shared professor repression

c) Ptolemaic = geocentric, Copernican = heliocentric & Tychonic = mixture of both (earth in middle sun goes around but mars & venus around the sun).

- In 1767, Mutis published *Reflexiones sobre el sistema tycónico*. (a) What were the main points of this publication?

(b) Was it considered controversial?

a) ① earth moves like our planets, but the sun & stars remain stagnant except for unique movement on sun's axis
② Copernican theory no means opposes holy scriptures
b) it was not considered controversial ideas.

- When Joaquín Velázquez de León and José de Gálvez arrived in Baja California, they remained there for three years. (a) What types of measurements did they make? (b) How did this improve local knowledge of Nueva

2. What was the purpose of the Milagro experiment?

- A: To observe the direction of incoming gamma-rays
- B: To observe the energy of incoming gamma-rays
- ☒ C: To observe the direction and energy of incoming gamma-rays
- D: To observe the charge of incoming gamma-rays

3. What upgrades to the Milagro concept were made that produced the HAWC design?

- A: Using oil instead of water as the detection medium
- B: Increasing the amount of water tanks to improve the sensitivity
- C: Moving the tanks to a higher altitude
- ☒ D: Both B and C

4. List some of the discoveries of HAWC and/or Milagro in the field of gamma-ray astrophysics.

- HAWC and Milagro made discoveries of black holes, PSR (pulse R)-neutron spinning star, and supernova (death of a star)

6 Modern Science in Latin America - Cosmic Ray Physics

1. What is the purpose of the Pierre Auger Observatory?

To study the overall concept of cosmic rays along with the idea of hope to figure out their origin where they come from



2. What is the typical energy of a cosmic-ray observed at Auger?


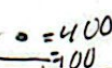
- A: 10^{12} eV
- B: 10^{14} eV
- C: 10^{16} eV
- ☒ D: 10^{18} eV

- d'Aueroche would work in San José del Cabo. What happened as a result?
- a) they made astronomical measurements orbital mechanics, geographical earth
- b) improved local knowledge by increasing mining activities, the port of San José del Cabo
- c) The result was that Joaquín Valero de Azaola went back to France because they wanted observations of the transit to communicate between Potosí and Paraguay. By doing this he established an important system for trade.

4 Applications, Mayan and Incan Number Systems

1. Work out the following exercises using the Mayan system. = 400


(a) $365 + 365 =$  $+ \text{same} =$  = $16 \times 20 = 320 = 730$


(b) $1024 - 512 =$  $- \text{same} =$  = $12 \times 20 = 240$

$400 \div 20 = 20$
 $20 \div 10 = 2$
 $2 \div 2 = 1$

$365 + 365 = 730$

2. Work out the following exercises using the Incan quipu:

(a) $512 + 256 =$  = 768

(b) $365 - 67 =$  = 700

b) $6 = 7$
 $60 = 60$
 $300 = 200$

3. Suppose we are looking for a set of trees tall enough to supply sixteen four-meter beams. Using the Mayan system, create a calculation showing that the total number of beams is sixty-four.

16 4m beams
 $16 \times 4 = 64$
 $64 = 3 \times 20 + 4 \times 20$

4. Suppose you have six terrace plots in the Andean mountains to use to survive. You and your cohort of fellow Incans decide to grow potatoes and quinoa. Quinoa actually do better at higher altitudes than potatoes. So the plan is to use the two lowest terraces for potatoes, and the upper four for quinoa. Each terrace is 30 meters by 5 meters. A potato plant requires a 0.2 meter by 0.2 meter patch, and a quinoa plant requires a 0.3 meter by 0.3 meter patch. How many potato plants and how many quinoa plants can you plant? Store the results in a diagram of quipu knot system.

Terres = $30m \times 5m = 150m^2$

Potato = $0.2m \times 0.2m$ (2)

Quinoa = $0.3m \times 0.3m$ (4)

$4 \times 150 = 600$
 $0.3 \times 0.3 = 0.09m^2$
 $600 \div 0.09 = 6666.67$

$0.2 \times 0.2 = 0.04m^2$

$300m^2 \div 0.04m^2 = 7500$ Potatoes

$4 = 4$
 $50 = 50$

5 Modern Science in Latin America - Gamma Ray Astrophysics

1. What is a gamma-ray?

- A: A charged particle with mass
- B: A neutral particle with mass
- C: A quantum of light