

COLL 300

Chem 360

Bodies That Matter: The Nature of Discovery in Science

(Short title: “**Bodies and Science**”)

Course Syllabus

Fall 2018

No man is an island,
entire of itself;
every man is a piece of the continent,
a part of the main.

If a clod be washed away by the sea,
Europe is the less,
as well as if a promontory were.
as well as if a manor of thy friend's
or of thine own were.

Any man's death diminishes me,
because I am involved in mankind;
and therefore never send to know for whom the bell tolls;
it tolls for thee.

(John Donne, 1572-1631, poem ca. 1623; Francis Bacon 1561-1626)

The focus of this proposed Chemistry 360 (COLL 300) course is on science as a *communal activity*, which has direct applicability to the COLL 300 theme of “Bodies That Matter.” This theme will be a unifying thread throughout the term. Scientific discovery and progress are often associated with a minimal number of “heroic” names: Lavoisier, Dalton, Mendeleev, Maxwell, Planck, Einstein, Watson, Crick, Salk, Banting, Marie Curie, Haber, Maxwell, Schrodinger, Salk, Fermi, Oppenheimer, etc. But, as T. Y. Cao contends,

... science as a human project for mastery over nature, human nature included, is essentially a *communal activity* (my italics), and [as such] cannot be underestimated. For, it is society [communal units] that gives science [its] problems, motivations and rewards, material and technical resources, and, in particular, ideas, metaphors and conceptual schemes for solving its problems and interpreting its results.

(Tian Yu Cao, “A Philosopher Looks at Science,” *Physics, Philosophy, and the Scientific Community: Essays in the Philosophy ...*, Springer, 1994)

Scholars have questioned the aptness and historical precision of the awarding of Nobel Prizes to only a select few (not more than three) individuals when the research triumphs take place with the context of several “bodies,” such as the body of scientists with subcategories of the bodies of physicists, chemists, biologists, mathematicians, etc., the body of observational data, the body of extant conceptual knowledge, the body politic that provides support for the research and bounds for the collective application of new knowledge, the body of graduate and post-doctoral students, etc. Should the awarding of scientific prizes be reexamined as expressed in two recent (2017) essays by Devang Mehta (*Mission*) and Ed Yong (*The Atlantic*) entitled “We should be rewarding discoveries, not individuals” and “The Absurdity of the Nobel Prizes in Science,” respectively. In this proposed course we will look at select areas of celebrated scientific achievement and explore in detail the literal/precise context (people, ideas, and events) of successful research that resulted in the awarding of Nobel and other significant prizes and acclaim. A prominent example of the limitation of a Nobel Prize to satisfactorily represent the science and scientists involved in a discovery is the 1923 Nobel Prize in Physiology or Medicine to Banting and Macleod “for the discovery of insulin.” Many people contributed to the work of Banting—in particular, James Collip Charles Best, and Nicolae Paulescu. In the view of many the Nobel committee not only unjustly excluded Best and Collip but equally unjustly included Macleod who contributed little to the science involved other than money and facilities to facilitate the research. Another example: Robert J. Oppenheimer, a brilliant man, is commonly referred to as the “father of the atomic bomb.” He

was indeed the scientific director of the Los Alamos laboratory, but there were more than 100,000 people involved in the Manhattan Project and hundreds of scientists and engineers at Los Alamos. Just who “fathered” the first atomic weapons is a multi-faceted issue—Teller, Bethe, Feynman, Szilard, Fermi, Neddermeyer, Wilson, Serber, and others made serious contributions to the bomb. And then, Antoine Laurent Lavoisier is considered to me the “father of modern chemistry,” but his work could not have come to closure without notable contributions for Bayen, Priestley, Cavendish, Black, Rutherford, Boyle and a technical compliment of glass blowers and instrument makers.

In this course we wish to pursue the thesis that the “bodies” approach rather than the “heroes” approach more accurately reflects the history and nature of scientific discovery. We wish to explore the idea that *communitarianism* (a system of social organization based on small governing communities) is a much more accurate and fertile understanding of triumphs in areas of science, both natural or social. Perhaps John Donne anticipated the true nature of science and was thinking of scientists when he wrote, “No man (scientist) is an island, entire of itself. Every man (scientist) is a piece of the continent, a part of the main (body of scientists).” Donne was, of course, a contemporary of Francis Bacon whose seminal work *Novum Organum* entails the basis of the “scientific method” as a means of observation and induction and whose work was commonly invoked as a guiding spirit of the Royal Society founded under Charles II in 1660.

Required texts (total cost for all texts ca. \$110—any format, hard, paper, Kindle, etc., is acceptable.)

1. *The Structure of Scientific Revolutions: 50th Anniversary Edition*, Thomas S. Kuhn, Ian Hacking (Introduction), University of Chicago Press, Fourth Edition, 2012).
2. *Whose Community? Which Interpretation?: Philosophical Hermeneutics ...*, Merold Westphal (Distinguished Professor of Philosophy, Fordham University), Baker Academic, 2009.
3. *The Annotated and Illustrated Double Helix*, James D. Watson, Alexander Gann, Jan Witkowski, Simon & Schuster; annotated edition, 2012.
4. *Marie Curie: A Life*, Susan Quinn, Da Capo Press, 1996. (Paper or Kindle, \$12)
5. *Manhattan Project: The Birth of the Atomic Bomb in the Words of Its Creators, Eyewitnesses, and Historians*, Cynthia C. Kelly and Richard Rhodes, Black Dog & Leventhal. 2009.
6. *The Alchemy of Air: A Jewish Genius, a Doomed Tycoon, and the Scientific Discovery That Fed the World but Fueled the Rise of Hitler*, Thomas Hager, Broadway Books, 2009.
7. *The Discovery of Insulin & Banting: A Biography* (25th anniversary edition), Michael Bliss, University of Chicago Press, 2013.

All other readings listed in the syllabus will be provided by the instructor.

=====

Schedule of classes, readings, and assignments

Week 1 and 2a. The Nature of Science—Part 1. Traditional View—Science as Method

Readings

1. Devang Mehta (ETH Zurich), We should be rewarding discoveries, not individuals, *www.massivesci.com*, October 3, 2017. Article provided.
2. Ed Yong, The Absurdity of the Nobel Prizes in Science, *The Atlantic*, <https://www.theatlantic.com/science/archive/2017/10/the-absurdity-of-the-nobel-prizes-in-science/541863/>, October 3, 2017. Article provided.
3. T. S. Kuhn, *The Structure of Scientific Revolutions*, 1962. The Introduction by Ian Hacking.
4. Merold Westphal (Distinguished Professor of Philosophy, Fordham University), *Whose Community? Which Interpretation? Philosophical Hermeneutics ...*, Baker Academic, 2009.

Assignments

1. Response questions to Ian Hacking’s Introduction to the 50th anniversary edition of Kuhn’s *Structure*.
2. Response paper to the idea of science as defined by method.

Week 2b and 3. The Nature of Science—Part 2. A different view—Science Defined by Subject Field Biological Evolution, Big Band, and Other “Myths” of Science—Relationships between the Humanities and Sciences (A detailed syllabus for this somewhat unusual topic is included.)

I. Introduction

Focus on physics

Terminology

II. Picasso—*Bulls, 1-11*

Semblance and Essence,

III. What is physics—a textbook example from the material world?

The hydrogen atom

Bunsen and Kirchhoff

Balmer and Rydberg

Bohr

Schrodinger

IV. Abstraction

Russell, *The Scientific Outlook*,

Whitehead, *Science and the Modern World*

V. Arshile Gorky and Chic-Fil-A—Back to semblance and essence

VI. What is physics—from a philosophical/metaphysical/foundational/essential perspective ?

Hegel, Lectures on Aesthetics, 1835

Klee, Creative Creed, 1920

V. A few summary aspects of the doing of physics

Russell

Whitehead

Hegel

Klee

VI. A different twist

Eldredge, *Waking the Dead*, Chapter 2, The Essential Mythical Nature of Humans.

The Matrix, The Wachowskis

St. Paul, 2 Corinthians 4:16-18, Ephesians 1:18

G. K. Chesterton

Roland Hein

Clyde Kilby

Heart and mind a la DWT

VII. What is physics—from a literary perspective?

Back to Schrodinger, physics, and abstraction

What is myth?

Griffiths, Wayne Teasdale, *Bede Griffiths: An Introduction to His Interspiritual Thought*, Skylight Paths Publishing, 2003.

Hamilton, *Mythology*, Little, Brown and Company, 1942.

Temple, *Nature, Man, and God*, Kessinger, 2003 from ca. 1934 Gifford Lectures.

VIII. More on literature and science

Ode on a Grecian Urn—Keats. Essence sweeter than semblance

IX. Summary comments from the humanities on the doing of physics

Saint-Exupery, *The Little Prince*

Rukeyser, *The Speed of Darkness*

Paul, Second Letter to the Corinthians

Keats, Ode on a Grecian Urn, Second stanza

X. Beauty

Coleridge, *On Posey and Art*

Keats, Ode on a Grecian Urn, Last stanza

Dirac, Beauty in physical theory

Chandrasekhar, Beauty in physical theory

T. S. Eliot, Dante essay and his misunderstanding of Keats

XI. Concluding Unscientific Postscript

All is one: The essential homogeneity of human intellectual endeavor

XII. A final look at Schrodinger: Schrodinger on Schrodinger's journey in physics

T. S. Eliot, *The Wasteland*, Little Gidding—on the nature of exploration.

Picasso's *Bulls*, 1-11; "I paint things as I think them, not as I see them."

All is one

XIII. Physics as a foundation to literary interpretation and criticism

Eliot

Poe

XIV. Back to the *Bulls*, 1-11—a postscript

XV. A generalized protocol for the realization of knowledge—the hermeneutical circle

The hydrogen atom again

XVI. On logos and mythos in early Greek thinking

Readings

1. John Horgan, *Is "Social Science" an Oxymoron*, *Scientific American*, 2013. Article provided.

2. John Eldredge, *Waking the Dead: The Glory of a Heart Fully Alive*, Thomas Nelson sold by HarperCollins, 2006. Selection provided.

3. Glenn W. Most, From Logos to Mythos in *From Myth to Reason? Studies in the Development of Greek Thought*, Edited by Richard Buxton. Article provided.

Assignments

1. Response paper to the idea of science defined by subject field and an essential similarity of the humanities and the sciences.

2. An essay on your understanding, from personal experience or otherwise, of beauty, that is, an essay addressing the topic What Is Beauty?

3. An essay of response to Edgar Allan Poe's poem *On Science*, which succinctly points out the tension between the sciences and humanities in the view of many

Week 4 and 5a. Thomas S. Kuhn: The Structure of Scientific Revolutions

Readings

1. T. S. Kuhn, *The Structure of Scientific Revolutions*, 1962. Chapters 1-13 and Postscript.

2. John Horgan, What Thomas Kuhn Really Thought about Scientific "Truth." Article provided.

Assignment

1. Response questions to Kuhn's *Structure*.

Week 5b. and 6a. The Overthrow of the Phlogiston Theory (1. The struggle and complexity of coming to coherent knowledge, 2. the necessity of community to Lavoisier's culminating triumph, and 3. Kuhn's cumulative versus revolutionary science dichotomy)

Readings

1. The Overthrow of the Phlogiston Theory by James B. Conant in *Harvard Case Studies of Experimental Science*. Paper provided.

2. Historical Structure of Scientific Discovery by Thomas S. Kuhn. Article provided.

3. Steven Weinberg, The Revolution That Didn't Happen (A response to Kuhn from a Nobel Prize physicist.) Article provided.

Assignment

1. (a) Questions on the phlogiston paradigm and its overthrow, and (b) An essay on whether the demise of the phlogiston theory fits the Kuhn criteria for a scientific revolution and how the research here fits the hermeneutical cycle scheme and a listing of 18th scientist who made crucial contributions to Lavoisier's culminating work.

Week 6b and 7 and 8. Birth and Culmination of Nuclear Physics and Chemistry. Marie Curie: "A Life" by Susan Quinn and "The Manhattan Project ..." by Kelly and Rhoades.

Reading

1. *Marie Curie: A Life* by Susan Quinn.
2. *Manhattan Project: The Birth of the Atomic Bomb in the Words of Its Creators, Eyewitnesses, and Historians*, Cynthia C. Kelly and Richard Rhodes
3. The docudrama *Fat Man and Little Boy* (the Manhattan Project).

Assignment

1. Becquerel positive knowledge questions and a response to the role of serendipity in scientific discovery
2. Response questions to Quinn's *Marie Curie*
3. An essay on J. Robert Oppenheimer and the administrative and operational structure of scientists and engineer of the Manhattan Project.

Week 9 and 10. The Search for the Structure of DNA: The Double Helix

Natural science as a thoroughly human activity including the Rosalind Franklins controversy and the treatment of women scholars in the mid twentieth century.

Reading

1. *The Double Helix* by James D. Watson.
2. *The Double Helix: A Study of Science in Context* by Ruth Hubbard (the mistreatment of Rosalind Franklin). Article provided.

Assignment

1. Questions on Watson's book and an essay regarding the treatment of Rosalind Franklin by Watson.
2. An essay on those left out of the Nobel Prize awarded for DNA—crucial science and scientists left out of the Nobel addresses by Watson and Crick. Also, should Wilkens have shared in the Prize—what did he do of significance?

Week 11. Science and World War I and II: The Alchemy of Air: A Jewish Genius, a Doomed Tycoon, and the Scientific Discovery That Fed the World but Fueled the Rise of Hitler

An integration of natural science, history, and social science within the European context from ca. 1871 through World War I with special interest in the role of science and corresponding technology in modern warfare including ethical/moral issues.

Reading

1. *The Alchemy of Air: A Jewish Genius, a Doomed Tycoon, and the Scientific Discovery That Fed the World but Fueled the Rise of Hitler* by Thomas Hager.

Assignment

1. Response questions to Hager book with an opinion paper as to whether Fritz Haber should have been tried as a war criminal and whether he should have been awarded the Nobel Prize in Chemistry

Week 12, 13, and 14. Glory Enough for All: The Discovery of Insulin

(Canadian Broadcasting Corporation dramatization of the discovery of insulin by Frederick Banting and others.)

Dramatized documentary of the 1921-22 Nobel Prize-winning discovery of insulin at the University of Toronto based on the book *The Discovery of Insulin & Banting: A Biography* by University of Toronto historian Michael Bliss (*The Discovery of Insulin*, University of Chicago Press, 25th anniversary edition, 2007; original edition 1982). The film title derived from the controversy involved in awarding the Nobel Prize to the appropriate researchers. Again, we see the human dimensions to the doing of natural science.

Reading

1. *The Discovery of Insulin & Banting: A Biography* (25th anniversary edition) by Michael Bliss.

Assignment

1. Narrative response to the question as to whether J. R. R. MacLeod should have shared in the Nobel Prize with Frederick Banting.
2. Reading questions related to the discovery, biochemistry, and medical dimensions of insulin.

Visitors' presentations—Three response/interpretation papers (400 words; 3% each of course grade)

“Bodies That Matter” is the unifying theme of this COLL 300 course. Students will be required to attend visitor presentations. They will prepare written responses (that is, interpretations invoking principles of the “hermeneutical cycle” conceptual framework developed in lecture) of the textual material presented giving special attention to (but not limited to) how “bodies” of varied sorts, people such as physicists/biologists/social scientists/etc., material particles, theories, empirical data, instrumentation, etc. affect the advancement of knowledge. While there are “heroes” in science, most commonly there is a context and background of previous work that was indispensable to the award of a Nobel Prize three or fewer individuals.

Additionally, students will be asked to consider the “prejudices” (*vorurteile*-Hans Georg Gadamer) that they bring to their interpretation of and response to the visitors' presentations and whether their interpretations are as objective and impartial as they might think. In *Truth and Method*, Gadamer says that history does not belong to us but rather we belong to history (to a tradition). Everyone brings to a text (including the “text” of nature) “prejudice” or what Gadamer refers to as an “historically effected consciousness” (*wirkungsgeschichtliches Bewusstsein*). In addition to understanding the context from which the visitors developed their narratives, the students will be encouraged to understand and expand the context from which they interpret/criticize the presentations.

All exact details of the external scholars' visits and presentations are not yet fully known. When more detailed information is available concerning presentations, it may be appropriate to invite one or more to meet with the class. At this early point it appears that all three of the visitors would be of interest to course themes. First, the course examines the role of science in both WWI and WWII resulting in ca. 75 million deaths. Mr. Peccerelli's perspectives in forensic anthropology applied to genocides in Guatemala and Bosnia and Herzegovina might well be worked into course themes involving the use of poison gas and atomic weapons to kill multitudes in the two wars. Secondly, the discrimination toward women in science is an ongoing theme of the course with attention given to Marie Curie (Nobel laureate), Marie-Anne Lavoisier (Lavoisier's wife), Rosalind Franklin (of double helix note), Clara Immerwahr (Fritz Haber's wife), Elizabeth Roach (Banting's finance), etc. The experiences and perspectives on the marginalization of women (and other minority groups) of Muthien and/or Cardenas should be of interest to the issue of the unwarranted treatment of women and minorities in the sciences and other areas of intellectual endeavors.

Students will be divided into small subgroups of three to five to share and discuss their responses/interpretations with one another, and then one group member (for each of the three visitor topics) will present a short summary to the class sharing areas of agreement and divergences followed by discussion.

Tests and course assignments

There will be two in-class lecture tests of ca. 50 minutes each. They will count 15% each of the course grade. The tests will be ca. 67% objective and ca. 33% essay. There will be a 1500 word final paper on a topic of your choice germane to the course theme. Your topic must be approved by the instructor. The paper will count 15%. The three response papers (ca. 500 words—these response papers are required by the COLL program) for external COLL 300 outside speaker presentations will count 4% each. There will be response papers (ca. 500 words counting 4% each) to each of the five acclaimed scientific triumphs scheduled in the syllabus. These triumphs include: Antoine Lavoisier (the role of oxygen in combustion and respiration), the Marie and Pierre Curie (the discovery of radioactivity), Robert Oppenheimer (culminating in the first two atomic weapons being used against the Japanese), Fritz Haber (ammonia and poison gas aiding Germany in WWI), and Frederick Banting (the life-saving discovery of insulin). These response papers will focus on the communitarian context (historical, sociological, scientific, etc.) and the “bodies” within that gave birth to these paradigmatic revolutions. The papers will focus on the multiplicity and complexity of circumstances that gave birth to these paradigm-altering discoveries and demonstrate that the individualistic “hero” approach to understanding scientific triumphs is often a serious oversimplification of reality. Other assorted short assignments associated with syllabus topics, particularly the readings assignments, will count a total of 18%. Students will prepare and present a “poster” (required of all COLL 300 students) based on the final paper or an equivalent topic at the On Campus COLL 300 Symposium (5%).

Absences and late assignments. Class attendance is required. Each student may miss one class for any reason. You may not miss student *presentations*. In order to be excused from attendance beyond the one absence listed above, you must contact me before the absence. If you have any scheduled, college sponsored travel that will cause you to miss a class, you need to notify me as soon as you find out about the trip. You will need to write a 150-word science news summary to turn in for each excused absence, for example, an illness or an out-of-town chess club tournament or a fencing trip. According to Departmental protocol *each unexcused absence will decrease your overall grade by one-third of a letter grade (e.g., A⁻ to B⁺)*. As or if necessary detailed and specific essay instructions will be posted throughout the semester.

Films, movies, documentaries, and such like. During these types of presentations the departmental protocol is that all electronic devices be effectively closed, e.g., computers, smart phones, cell phones, tablets, etc.

Visitors.

[Fredy Peccerelli](#) is director of the Guatemalan Forensic Anthropology Foundation. FAFG carries out exhumations of Guatemala's clandestine cemeteries from its civil war (1960 to 1996) and works to identify victims of massacre and return bodies to families and communities for proper reburial. His engagements on campus will focus on his own journey in this work: his life as a young political refugee in NYC in the 1980s, coming to know about his country's armed conflict, the work of forensic anthropologists in documenting "truth," and his founding of and work in FAFG. His visit is scheduled for September 17-21. The main event will take place September 19, at 5 pm in Commonwealth Auditorium.

[Bernedette Muthien](#) is an activist, poet, educator, and government minister. Her life's work has been directed toward increasing access to basic social institutions that have long excluded women, and in particular women of color, in South Africa. Her visit will focus on her passion and strategies for reversing patterns of victimization through increased representation and access to education, financial institutions, and government services. Her visit is scheduled for October 8-12. The main event will take place October 10, at 5 pm in Commonwealth Auditorium.

[micha cárdenas](#) Ph.D., has been using technology for art and social justice for more than a decade. Inspired by her Latinx spiritual ancestors Gloria Anzaldúa and Sylvia Rivera, she works to challenge borders of all kinds, including borders between academia and activism, poetry and politics. She combines theory and practice to consider how algorithms are like rituals, recipes, and poems, and can be used for racial and gender justice, including the reduction of violence against trans women of color. Currently she writing a new algorithm for gender, race, and technology. She is Assistant Professor of Art & Design: Games + Playable Media at the University of California, Santa Cruz and has co-authored the books *The Transreal: Political Aesthetics of Crossing Realities* (2012) and *Trans Desire / Affective Cyborgs* (2010). A first-generation Colombian-American, she is the inaugural recipient of the James Tiptree Jr. fellowship in 2014, a fellowship to provide support and recognition for the new voices in science fiction who are making visible the forces that are changing our view of gender. Her artwork has been described as "a seminal milestone for artistic engagement in VR" by *Spike* art journal in Berlin. Her visit is scheduled for October 17-19. The main event will take place on October 17, at 5 pm in Commonwealth Auditorium.