

Chemistry 1905 — Freshman Seminar (Sec 3, 2 Cr)

Scientific Progress: Dynamics and Impacts on Practitioners, Popular Culture, and Policy

Spring 2010

- Instructor:** Christopher J. Cramer
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- Meets:** Wednesday, 3:35 pm - 5:15 pm. 111 Smith Hall
- Texts:** *Lise Meitner: A Life in Physics*, by Ruth Lewin Sime (ISBN 0520208609)
The Billion Dollar Molecule, by Barry Werth (ISBN 0671510576)
- Office Hours:** By appointment or whenever
- Prerequisite:** None
- Coursework:** We will spend roughly the *first* half of each class discussing the reading assigned for that week. To facilitate discussion, I have compiled lists of possible topics to be addressed for each block of reading, and these lists can be found at the end of this syllabus. **Prior to class meeting each week, students are responsible for providing me with one paragraph (preferably by email) that either responds to any one or more of these questions or addresses any other topic from the week's reading that they think is interesting**—there is no requirement to limit oneself to the list of topics in the syllabus.
- In addition, for the *second* half of each class, all participants are responsible for identifying at least one topic in the week's news that involves science/technology interacting with broader society in one way or another. Students should be prepared to summarize the story/issue and initiate a class discussion centered upon it. As we are likely to cover several topics each class, summaries need not be extensive—oral presentation alone is perfectly acceptable—but summaries should be sufficiently comprehensive to permit informed discussion. **A one sentence summary of the topic should be sent to me by email before class begins**; you may feel free to either send this item with your discussion paragraph or separately..
- Exams:** None.

Grading: The final grade in the course will be based on (i) providing weekly paragraph responses as outlined above, (ii) participation in classroom discussions, and (iii) presentations. "A" work will involve providing the required paragraph responses **on-time** every week, and showing creativity and initiative in discussions and presentations. "B" work will show less creativity but still be timely and complete, with no more than two (unexcused) late paragraph responses. "C" work and below frankly requires more lack of effort than it is worth. I note that I will have no objection to awarding all A grades in this class if circumstances warrant.

I am happy to discuss my impression of your grade so far at any point.

Reading: Below is the reading schedule by class. By class time, your reading should be complete through the indicated page number. The last week is left unassigned just in case we need to miss a class or some relevant opportunity comes up to have a guest visitor or event.

01/20	Sime pp. 1–75	03/24	Werth pp. 59–137
01/27	Sime pp. 76–133	03/31	Werth pp. 138–190
02/03	no class (instructor away)	04/07	Werth pp. 191–252
02/10	Sime pp. 134–209	04/14	Werth pp. 253–317
02/17	Sime pp. 210–278	04/21	Werth pp. 318–370
02/24	Sime pp. 279–346	04/28	Werth pp. 371–429
03/03	Sime pp. 347–380	05/05	Overflow/open
03/10	Werth pp. 1–58		

Possible topics for Sime pp. 1-75:

- 1) What sorts of challenges did Meitner face as a girl/woman compared to boys/men? To what extent were prevailing attitudes associated with local culture (e.g., would things have been different in the US at the time?) How have things changed today, or how have they stayed the same?
- 2) What major names in science appear in these first 3 chapters that you recognize? Did you learn anything more about them than you knew previously?
- 3) In a few instances, we are presented with science as almost a battle between opposing camps. Which cases stand out for you and why?
- 4) What role is religion playing in these early chapters?
- 5) Certain themes will run throughout this book that merit ongoing attention.
 - a) Chemistry vs. physics. How do the scientists identify themselves and what difference does it make?
 - b) Science vs. politics. How are they interrelated and how are some of the actors in the book affected by trying to deal with only one, or the other, or both.
 - c) Nationalism vs. internationalism. What pressures influence individuals to conform to one or the other viewpoint.
 - d) Science vs. art. To what extent do the key personages in Sime expand their horizons beyond their science and what does this say about the time or the culture?
- 6) The descriptions of World War I are quite riveting in many respects. What things most caught your attention? How was warfare different then compared to now? How the same?
- 7) The time period under study represents a transformative one in many respects, but particularly for the relationship between science and society in general. How were things different then compared to now (or similar, if certain things have not changed)?

Possible topics (some continue from last time) for Sime pp. 76-133:

- 1) How has Meitner changed with time? What sorts of challenges has she overcome and which remain?
- 2) Certain themes will run throughout this book that merit ongoing attention.

a) Chemistry vs. physics. How do the scientists identify themselves and what difference does it make?

b) Science vs. politics. How are they interrelated and how are some of the actors in the book affected by trying to deal with only one, or the other, or both.

c) Nationalism vs. internationalism. What pressures influence individuals to conform to one or the other viewpoint.

d) Science vs. art. To what extent do the key personages in Sime expand their horizons beyond their science and what does this say about the time or the culture?

3) Were you previously familiar with the history of post-WWI Germany? What analogies are there for this period compared to the modern day?

4) In a few instances, we are presented with science as almost a battle between opposing camps. Which cases stand out for you and why? How do the scientific battles compare to the more conventional warfare ones?

5) There are some amazing bursts of creativity described in this period -- did any strike you in particular?

6) Did you notice the interesting comment about Schrödinger and his wife?

7) There is a fascinating disconnect between theory and experiment during this period. How does this affect things? Are scientists different than the general public in their dealings with such situations.

8) U235 was first purified at the University of Minnesota -- know how?

9) Another gee-whiz question -- do you know the controversy of Lord Kelvin and his prediction for the age of the earth and how radioactivity resolved it?

10) The positron, the neutrino, the neutron -- what a time of discovery! (Even if you DON'T like nuclear physics.) But now it's 1933 in Germany. Uh oh...

Possible topics (some continue from last time) for Sime pp. 134-209:

1) In the book, does the rise of the Third Reich seem to go quickly or slowly from your perspective?

2) How do the scientists inside and outside Germany react to the changing political winds? What influences their response (or lack thereof)?

- 3) How can a nation subscribe so wholeheartedly to the policies that led to the dismissal of all non-Aryan faculty and scientists?
- 4) People are rarely confronted with stark choices between good and evil -- instead they travel a path of seemingly minor compromises but always in one direction. What examples do we see of minor compromises that contribute to the deteriorating situation?
- 5) Many of the Nazis are portrayed as hypernationalists -- are there parallels with the post-9/11 United States that bear consideration?
- 6) Why does the Nazi regime express "contempt for scholarship or scientific research"? (p. 145)
- 7) The situation with Meitner is a tragedy, but there are so many others. Which ones struck you most?
- 8) The chapter on physics (Toward the Discovery of Fission) illustrates the complex internationalism of science at the time compared to the political nationalism. How do the two influence on another?
- 9) What factors made it most difficult for Meitner to escape from Germany? Are some of them very different from what one might face today in a similar situation, or are most unchanged?
- 10) We get a few seemingly clear-cut heroes and clear-cut villains in these chapters. Who would you put in these categories at the moment?

Possible topics (some continue from last time) for Sime pp. 210-278:

- 1) How does the relationship between Hahn and Meitner change because of their geographic separation? What changes the most and what most stays the same?
- 2) Meitner is effectively in exile. What keeps her going and what challenges her the most?
- 3) How are the Nazis stepping up their harassment of Meitner and others in general?
- 4) People are rarely confronted with stark choices between good and evil -- instead they travel a path of seemingly minor compromises but always in one direction. What examples do we see of minor compromises that contribute to the deteriorating situation?

- 5) Isn't the description of Meitner and Frisch working out fission on a tree stump in the snow beautiful? What other classic "eureka" discoveries come to mind?
- 6) How does Siegbahn come across?
- 7) Priority is the title of a chapter? What were the stakes associated with priority?
- 8) Did any of the pictures/photographs catch your attention in a particular way?
- 9) The case of Noddack is an interesting one. Does Sime seem inclined to step around it? Does it deserve more attention?
- 10) Did you notice Minnesota's brief moment in the story?

Possible topics for Sime pp. 279-346:

- 1) What changes are brought by the onset of WWII? In particular, what are the personal and the scientific impacts with respect to Meitner?
- 2) The story of von Laue's Nobel medal is one of the most wonderful scientific stories around—for more details, see the final paragraph on the page at http://nobelprize.org/nobel_prizes/medals/.
- 3) We get to see substantially more character development for Hahn and Siegbahn. Do we still love to hate them? Is there any reason to question Sime's objectivity as an historian?
- 4) The Nazi's final solution for the Jews now unfolds in full. Did any of the stories of individuals stand out for you in particular? Kohn? Rubens? Berliner?
- 5) We get some wonderful insights into the politics of the Nobel prizes and the selection of awardees. Would you have imagined that a scientific prize would somehow be above petty politics?
- 6) On the uplifting side, the escape of the Danish Jews, and Bohr's honor and dignity are shining stories.
- 7) How does the war affect fission research? What moral questions are raised?
- 8) What do you think of the quote extending from pp. 301-302?
- 9) Physics and politics become inextricably entwined in the post-war nuclear age. How do the physicists deal with their new responsibilities? What considerations weigh on their conscience?

10) The Farm Hall conversations are fascinating — like watching a play with characters trapped in a room. Do any of the principals come away looking better or worse than the others?

11) The war turned many ordinary people into heroes (or villains). I personally like the Paul Rosbaud story.

12) How do Meitner's travels in America affect her?

Possible topics for Sime pp. 347-380:

1) Sweden, like many countries, scrambled to institute a nuclear program after the war. One could say that the nuclear discoveries were transformational at a fundamental political/national level. Are there other developments, in more distant or more recent history, that have been similarly transformative?

2) Meitner went back to Germany regularly after the war, Einstein refused to. Who do you think did the right thing? What motivated Meitner differently than Einstein?

3) Meitner faced any number of challenges throughout her career -- which were most difficult for her and how might they continue to apply (or not) today to a similar scientist?

4) One might say that any realistic story that unfolds over time may be read as a loss of innocence. What are examples of loss of innocence in the book as a whole? These need not be specifically associated with Meitner, or with any single individual.

5) Did Meitner take any actions (or decide not to) that surprised you in these last two chapters?

6) Denazification in 1945, deBaathification (in Iraq) in 2003. Are there any interesting similarities or differences?

7) von Laue emerges as an increasingly complex character in these last two chapters. What do you think guided his thoughts and opinions?

8) Can history ever be made to be "accurate"? How can we resolve the disparity in different accounts of Hahn's vs. Meitner's contributions to the discovery of fission?

9) The quote from Lise's letter to Hahn at the bottom of p. 369 is quite beautiful (in my opinion).

10) On p. 375, Meitner suggests that “spiritually and morally we are in no way keeping pace with technical advances.” Do you think this was true? Is it still true? What can be done to improve the situation if it *is* true?

11) If you had to assign a genre to this biography, would you say that Meitner’s life was a triumph or a tragedy?

12) To whom would you recommend this book, if anyone? Which parts interested you most, and which least? What improvements might have been possible, from your perspective?

Possible topics for Werth pp. 1-58 :

1) First, not a discussion point but for information, my personal expertise encompasses drug design far more than nuclear physics. So, if you have questions about any of the science in these (or subsequent) chapters, please do not hesitate to ask.

2) Did you find any of the characters surprising? That is, to the extent that you might have had certain stereotypes about certain professions/ roles, did you find that the real people in those roles seemed very different from such stereotypes?

3) What did you know about the pharmaceutical industry before starting this book? Were there aspects of the industry, revealed in these first few chapters, that you found surprising? How do things compare with other large industries?

4) Which character(s) do you find most sympathetic? Most intriguing? Most unusual?

5) The book begins to show us the close relationship that can exist between for-profit operations and universities. To what extent should universities make use of such relationships to raise money? What are the potential dangers of such relationships?

6) How is the writing in this book different from that in Sime? Do you have a preference for style?

7) Why do you think Boger left Merck?

8) It costs money to do research, and sometimes the profit motive can generate that money. What are the limitations associated with this process from a societal standpoint?

9) Who would have thought that the Norwegian heavy-water plant would turn up again?

10) Some of the pros and cons of animal models turn up in the sections discussing transplant research. What ethical issues are implicit? This book was published in 1994. Were you surprised to learn what the state of the art was in the immediately preceding years (around the time of your birth, I imagine...)

11) The early results from FK-506 were so promising that many patients began to beg for it in clinical trials that were designed to test its effectiveness in blind comparisons. What ethical issues arise in the design and modification of drug studies?

12) Organ transplants are described as moving into a stage where the limiting factor was availability of organs. What is a fair system for determining how to distribute organs if supply is limited?

13) The Reagans pop up once or twice. How can medicine and politics intersect? What are the potential benefits or complications from such intersection?

Possible topics for Werth pp. 59-137:

1) We meet (or see much more developed) a few new characters -- Thomson, Aldrich, Schmidt, Navia, Tischler -- what stereotypes, if any, do they fit or fail to fit? Did you find any of them particularly interesting or noteworthy?

2) Did you recognize some of the drugs in the stories of early efforts by the pharmaceutical "industry"? Did you know any of the histories? Were you surprised by any of the details?

3) Had you heard of the 1918 flu? Do you know much about it? Are you planning to get a flu shot?

4) These chapters focus a bit more on business and less on science. You might even miss the science if not looking for it. Care to guess on the proportion of money invested in research compared to, say, marketing, legally protecting, etc., a drug?

5) The wonder drug stories are quite remarkable -- has there been a similar story or stories in the more recent past that you can think of?

6) How is the writing in this book different from that in Sime? Do you have a preference for style? (We didn't really talk about this last time).

7) Should Boger have left Merck? To whom did he have obligations and what were they?

8) How did the issue of profit vs. societal benefit come up here and there in the last few chapters?

- 9) Do you know who Vannevar Bush was? He has a nice Wikipedia page...
- 10) Harvard keeps coming up again and again in different contexts. Were there any aspects of this that you noticed or wondered about?
- 11) Who (in a general sense) is missing from this book (so far)?

Possible topics for Werth pp. 138-190:

- 1) We get the opportunity to make comparisons of Japan, the U.S., and England in the context of the story. What contrasts do you see and what similarities?
- 2) The events in this book take place in the early 1990s. What, if any, events or descriptions seemed to you to be very different from 2008? What things seem not to have changed at all?
- 3) What do you think of the connection between the science and the deal-making, as described in the book thus far? What, if anything, makes a drug-company start-up different from some other sort of start-up company?
- 4) What are the symbols that convey status to different people in the story? How do they reflect on culture?
- 5) Are there characters that you do *not* like at this point? What's given you that feeling?
- 6) Are there characters that you particularly *do* like at this point? What's given you that feeling?
- 7) Had you previously heard of X-ray crystallography? The description on p. 154 is remarkably vivid and readable.
- 8) The number of scientists at Vertex is increasing, although we are meeting relatively few new ones. What sort of dynamics between them seem different than you might see in any average group of co-workers, if any?
- 9) We get some more time with Starzl. Is he a more rounded character for you now?
- 10) If you were to have been a contemporary of the events as far as we have read, would you have been inclined to buy stock in Vertex?

Possible topics for Werth pp. 191-252:

- 1) We get a much more complete picture of Schreiber to start Part 2. Werth clearly intends Schreiber and Boger to be foils for one another. What contrasts do you see and what similarities between the two? If you have different opinions about the two, what factors give rise to such a difference?
- 2) It seems that organic chemistry doesn't lack for personalities. How does Woodward compare to some of the other figures to have appeared so far?
- 3) What do you think of the connection between the science and the deal-making, as described in the book thus far? What, if anything, makes a drug-company start-up different from some other sort of start-up company? (didn't do this one last week)
- 4) Had you heard previously of Linus Pauling? He has only a bit part here, on pp. 203-204, but he was quite a figure in popular science for a long period.
- 5) It's better to be lucky than to be good (or so it is said -- it's ideal to be both). What strokes of luck have we read about so far that had large scientific impacts ?
- 6) Are you developing a better feel for what else is going on at Vertex? Have you been surprised by the amount of work that goes into research compared to the frequency of success in generating useful drugs?
- 7) On p. 218, the "standard" model of measuring research productivity is described, and Boger and Armistead are said to disdain it. Does it merit such disdain, in your opinion?
- 8) We are led to understand, again, on pp. 219 and 234, that the whole basis for Vertex's existence could be a wild goose chase -- do you understand the scientific issue? What must it take for Boger to maintain the confidence of the entire Vertex workforce? How would you have felt, as a Vertex scientist hearing these things?
- 9) It is noted, on p. 224, that the overwhelming majority of organic chemists are men. Fifteen years after this book's publication, that hasn't changed -- why IS that?
- 10) If you were to have been a contemporary of the events as far as we have read, would you have been inclined to buy stock in Vertex? (didn't do this one last week either)
- 11) Is Yamashita paranoid, or realistic?
- 12) Harding gives his own blood to retest the efficacy of his V-367 lead. It just doesn't get better than this for Werth...

Possible topics for Werth pp. 253–317:

- 1) What similarities, if any, do you see between the Wall street situations of the early 1990s and the last few years?
- 2) How are the demands of science and business different for the people at Vertex? What tensions are introduced because of their conflicting priorities?
- 3) Do you appreciate the difference between a publication and a patent? Why do you think Boger refers to aggressive patenting as “throwing nails off the back of the truck”?
- 4) We continue to be offered examples of Boger’s unshakeable optimism and drive. Which ones were most notable?
- 5) What did you think of the description of the beginning of AIDS research? Did you hear the discussion in the media of the Nobel prize in medicine this year (which was given to French AIDS researchers)?
- 6) We hear again and again about crises that require new “Manhattan projects” (e.g., AIDS research on p. 271)--have we had a countrywide effort as successful as the Manhattan project since 1945?
- 7) Sigal died in the Lockerbie bombing. Is it not remarkable how many major events of the 1990s somehow intersect with the Vertex story?
- 8) Yamashita’s story keeps getting more and more interesting. Is Werth’s amateur psychoanalysis on target, in your opinion?
- 9) Do you see similarities between the activities of Vertex and the experience of war?
- 10) There is a nice description of the problems of Alzheimer’s research on p. 298. Alzheimer’s continues to be a very hot area, and all the listed problems remain serious ones.
- 11) Boger suggests that stockholders (“the unwashed public”) should not have the right to question scientists in a drug company. What IS the proper way to execute oversight, whether on behalf of stockholders or a government program?

Possible topics for Werth pp. 318–370:

- 1) There are some jarring contrasts between individuals acting as scientists in a “pure science” mode and their other activities. What were some of the key ones that caught your eye?

- 2) How are the demands of science and business different for the people at Vertex? What tensions are introduced because of their conflicting priorities?
- 3) Was there a sense of irony at the end of this week's reading along the lines of "we inevitably become our parents"?
- 4) Werth has a tendency, either annoying or insightful, to offer pop psychological insights into characters. Have you noticed this? Did any seem particularly on or off the mark?
- 5) Did you know how IPOs work before this week's reading? Which parts of the process seemed noteworthy?
- 6) Authorship on papers continues to be a topic that attracts great interest in scientific ethics courses. What criteria should determine who is an author?
- 7) What examples of intellectual dishonesty (or, perhaps more charitably, wishful thinking) appear in this week's reading?
- 8) Who is your favorite character at this point (whether for good or ill)?
- 9) Does Boger's father's suicide seem to have had any effect on him?
- 10) When Boger says (on p. 348) that perhaps he should put aside drug development and "address the level of scientific education in America", is he on target or condescending?

Possible topics for Werth pp. 371–429:

Having reached the end of the book, we can now consider its full scope.

- 1) Did it seem anticlimactic that, in the end, FK-506 turned out to be a dead end?
- 2) The start-up of Vertex is a crucible for its personnel. Which people grew in the process and impressed you? Which failed to grow? What about the important characters outside of Vertex, e.g., Schreiber and Starzl?
- 3) What did you learn from this book that you didn't know previously?
- 4) What were the most interesting contrasts that Werth presented between ideas, groups of people, motivations, etc.?
- 5) What can I do next semester to make the study of this book (or of Sime) more informative or interesting?