

Microbiology 213 Social Issues in Biology- January 28, 2010

What is Science: Evolution vs. Intelligent Design

Discussion of the PBS Nova Film: "Judgment Day: Intelligent Design on Trial"

This film is based on a 2004 court trial about the teaching of evolutionary theory in the schools of Dover, Pennsylvania. The portion in which the trial itself is "filmed" uses actors to represent those participating in the trial. Actual films or videos of the trial were not available.

In watching this film, please consider the questions below and take notes if you can.

1. What is science? How is it defined, particularly, in this film, by Kenneth Miller? Do you agree with his points, with regard to Evolutionary theory, or to science, in general? Is astrology a scientific theory?
2. What is said to distinguish Evolutionary theory from Intelligent Design theory?
3. Do you think that the arguments made by scientists against specific criticisms made by Intelligent Design advocates are airtight: for example on the issues of the flagella or the immune system?
4. Is the show objective?
5. What is meant by the word paradigm in this context? What is your understanding of the word?
6. One of the people interviewed in the film is Steve Fuller who is a sociologist of science. Do you understand what point he is trying to make?
7. The population of the United States lags behind that of most other "Western" countries in its belief in evolutionary theory? Is this a problem?
8. If you think this is a problem and that the resistance to teaching evolution by those presenting creationist/intelligent design alternatives is a problem, who should be counteracting these ideas? How?

Readings FYI:

J.D. Mills, E.C. Scott and S. Okamoto. Public acceptance of evolution. Science 313:765-766 (2006)

P. Kitcher. "Evolution, Design and Faith" Oxford University Press (2007).

MICROBIOLOGY 213. Social Issues in Biology: February 4, 2010

What is Science?

Please read Thomas Kuhn's book "The Structure of Scientific Revolutions," (1962) University of Chicago Press third edition (available at the Coop course section in Harvard Square- under Biology 213) which includes a 1969 postscript. Focus on the pages that are the original text of his book (pp 1-173), although you might want to read the Postscript (optional). This is the only reading for today.

Kuhn's book has stimulated debates and controversy that continue to this day. These include questioning of the specifics of his thesis including whether revolutions in science really take place as he describes. His book has also influenced academics in other fields who study the scientific process, leading them sometimes to using Kuhn as justification for an extreme position on the relativism of scientific truths. Some scientists fear that these arguments hurt science and blame Kuhn for this result.

Aside from the question of how widely Kuhn's descriptions can be applied to science, I, personally, have found the book to be rich with insights into the scientific process. Not only do I think that these insights are useful, at the least, in musing about the science we do, but also in considering many of the issues we will discuss this semester.

As you read the book, please be thinking about the set of issues/questions I have listed below. For each of these, do you find Kuhn's explanations compelling or do you see problems with them? Come prepared to talk on either "side." There is practically no biology in this book. Why? As you read through the book, can you think of examples from biology/genetics/molecular biology that would fit into the discussion?

Can you relate Kuhn's ideas to aspects of the film we saw last time on Evolution vs. Intelligent Design?

1. What is "normal science?" (A brief summary of what is a paradigm is necessary here.) What do "normal scientists" do? How does normal science make it difficult for new paradigms to emerge? Does normal science resist "novelty?" Is this a good thing for scientific progress? Can you seek novelty? How does normal science result in paradigm changes?
2. How does a paradigm shift take place? What are the factors that Kuhn says make successful acceptance of the shift (or cause resistance to the shift)? Make a list of these factors which might include the scientific, personal, social, political and the psychological (others?). These would include features of the paradigm itself and other extraneous factors. Would you add any of your own?
3. What does it mean to talk about fields of research that are paradigm based or non-paradigm based or pre-paradigmatic? Examples?
4. Explain Kuhn's use of the term "incommensurability" of competing paradigms. (pp.98-100; 103-104) is one place where this is discussed. Do you have any problems with this characterization?

5. Kuhn mentions scientific positivism, verificationism and falsificationism (Karl Popper). Do you know what these terms mean. Do you agree with his critique of each individually as a critique of the description of how science is done?

6. The book actually begins with a critique of the education of scientists. Is the education/texts that he criticizes something you have experienced or is it different from what he describes? If some of his criticisms (also throughout the book) of the education of scientists are accurate, should the education of scientists be changed?

7. Perhaps most disturbing to many is the idea summarized in on p. 170 that “We may.... have to relinquish the notion..... that changes of paradigm carry scientists and those who learn from them closer and closer to the truth.” What does he mean by this? Does he believe in progress? Do you agree or disagree?

8.. As indicated above, come with some thoughts about paradigm changes in biology. Kuhn talks of some of the big paradigms, but he also allows one to think in the same terms of smaller “paradigms.” So, don’t restrict yourself to just major paradigms of biology.

Finally, do Kuhn’s ideas challenge any of your own beliefs about science? Do you disagree with his ideas? If that is the case, come with arguments for why you think some of his analysis is incorrect? And, do you think it makes any difference whether or not people accept his views of science? Which people? Scientists? The Public? Journalists?

Microbiology 213
Social Issues in Biology
February 11, 2010

The Science of Behavior, Ethnicity and Race: History

This is the first of three sessions that will include at least some discussions of biology and race. This session focuses largely on historical examples.

The two required books (S.J. Gould's *Mismeasure of Man* and J. Beckwith's *Making Genes, Making Waves*) should be available in the Biology 213 course section at the Coop by this Friday. The Beckwith book might come later and I will let you know if that is the case.

Readings:

1. S. J. Gould. **The Mismeasure of Man** (revised and expanded). Norton paperback. (1996). Please read pages **51-105 and 176-222 and pp. 264-269** on Sir Cyril Burt (up to "Correlation")

In the first session, we looked at the attempts of the Intelligent Design promoters to counter evolutionary theory- attempts considered to be an attack on science. In this session, rather than questioning the arguments of those outside science who criticize science, here we look at debates about the validity of research produced in particular areas of science. Here we look critically at some history of the science done on human behavior and intelligence. The Gould book is worth reading from cover to cover, but that would be much too much for one session. We will be reading a couple of short sections in subsequent sessions. But, when you have some time I think you will find other parts of the book that we don't cover pretty interesting.

Overall, as you read Gould, think about his critiques in terms of the issues we have discussed in the first two sessions (see e.g. p.54). Were researchers such as Morton, Goddard, etc. doing science? Can you think of other reasonable explanations for how Morton got his results? Do you consider these cases represent good science, bad science, or just science? Why might Burt have gone to such extremes in concocting data in his identical twin studies? What factors can lead to the kind of fraud apparently committed by Burt? Are these factors present in our own science? What factors might have influenced their science, their assumptions even to the point of apparently committing fraud in the case of Burt? Are we free of such influences today? What factors might have influenced or provoked Gould's critique? Do the concepts of paradigms, normal science or pre-paradigmatic science have any relevance here?

Stephen Jay Gould was a paleontologist who made major contributions in his field and in evolutionary theory. He was also active all his life in exposing what he felt was misrepresentation/misuse of science to influence social programs and policies. This also included testifying at court trials in defense of the teaching of evolution, under attack by creationists in various states.

Be prepared to discuss each example of research and theories offered by the various scientists Gould cites. Gould himself repeatedly states that non-objective factors are just as prevalent in all the science we do. Are his arguments convincing?

Consider the examples of Morton and Burt. First, are you persuaded by Gould about Morton's studies?

On p. 269, Gould says that Burt's work has "affected millions of lives." What is he referring to?

Other themes that come up in Gould:

His repeated discussion of quantitation in science as being misused as the ultimate objective criteria. (first brought up on p. 58)

In page 77-78, issues arise as to why certain scientific subjects are studied.

The failure to consider alternative hypotheses for data.

On page 186, be sure you understand the "two false implications" that he describes. These are expanded on in detail in the other major reading in this session.

I have not required reading of the section on factor analysis in the Gould book as I thought there was already a substantial amount of reading and this would require significantly more work and I'm not very good at it.

2. Figure (cartoon) of the Kallikak family from a widely used psychology text published in the early 1960's. L. Zenderland. (1998) **Measuring Minds: Henry Herbert Goddard and the Origins of American Intelligence Testing**. Cambridge Univ. Press. Cambridge, England. (paperback), pp. 352-353. and discussion of Goddard's Regrets, summary of some of Zenderland's findings excerpted from <http://www.iub.edu/~intell/kallikak.shtml> (You don't have to access the website- the excerpts are in one of the files for this week.

What do you learn from these comments? Gould admitted one error of his in his book and Zenderland suggests another in the discussion of the pictures of the Kallikaks. Does that make you mistrust Gould? What do you learn from these examples?

The impact of Goddard's work on Nazi German ideas is not the only example where this has occurred. Many studies from the U.S. promoting the ideas of eugenics were cited frequently in support of Nazi policies. See next reading.

3. J. Beckwith. Chapter 7 "Their Own Atomic History" in **Making Genes, Making Waves: A Social Activist in Science**. Harvard University Press, Cambridge (Hardback) pp. 98-115 (2002).

This is my brief summary of and take on the eugenics movement in the early part of the 20th century. How much blame for the consequences of this movement, if any, should be put on the shoulders of the scientists involved? What should they have done differently?

Some would argue that this 20th century eugenics movement gave the word "eugenics" a bad reputation and that there is a good eugenics. What does that mean? Are there arguments for the eugenics being made today that resemble the ideas put forth ~100 years ago?

Microbiology 213, February 18, 2010
Race and Genetics: into the 21st Century

In the last session, we learned of arguments made by scientists about differences in intelligence between groups that was based on craniometric studies to twin studies on a genetic basis for differences. Today's session starts with what I think is an important analysis and critique by Sober of the use of heritability of traits such as intelligence that is estimated from twin studies. We then proceed to

1. E. Sober. 2001. Separating nature and nurture. In Genetics and Criminal Behavior, eds. D. Wasserman and R. Wachbroit. Cambridge University Press, Cambridge. Pp. 47-78.

Please be prepared to present the essentials of Sober's argument. This reading goes into depth on the concept of heritability, discussed in Gould, which is central to the reports of Sir Cyril Burt and many other studies that continue to the present day. To me, Sober's is one of the best in explaining available for the concept, its problems and its uses and potential misuses in twin and family studies. Don't get hung up on the more mathematically-based formulations. I think the concepts are clear without a full understanding of the math. Sober here goes into detail on the meaning of heritability and what is or isn't learned from studies such as those done with identical twins. Often heritability is taken to mean inherited, which, Sober (and others), makes clear it doesn't. With the mistaken interpretation of heritability, such studies are given a genetic determinist slant. The concepts of gene-environment interaction and gene-environment correlation are important for seeing the complexity of interpretation particularly in genetic studies of human behavior. Can you see why? Are these arguments new to you? Are you aware of examples of the misrepresentation of heritability studies that have had social implications?

How many have a background where you have studied in classes the concept of heritability? Did you learn anything new here?

Other questions to think about:

p. 37 "whether a scientific question should be pursued depends on what the consequences for human welfare would be of pursuing it?" What does this mean? What is human welfare?

p. 61, 62 Why is the issue of controlling for "trait-relevant" environmental variables important. How do you choose which one to assess?

p. 68, 70 How would you test whether the equal environments assumption is correct or not?

p. 71 gene-environment correlation

p.73 Be sure you understand what Sober is trying to say with the redhead example

Sober's clear explanation of the problems is important today because much of the expectations of geneticists that they would readily find genes for many human traits have encountered enormous difficulties. They and the media now talk about the puzzling gap between findings of strong heritability of a trait and failure to find the genes that could account for it.

(I suggest that if you want to read more about the problems with the attempts to show a genetic basis for IQ score difference between social classes and racial groups, look at some of the early chapters of R.E. Nisbett's "Intelligence and How to Get It" just out in paperback. It is popularly written but academically sound and heavily referenced.)

2. A brief history of the idea of race?

S.J. Gould. **The Mismeasure of Man** . Norton paperback (1996). Page 398 (beginning with 2d paragraph) through page 412.

The first pages, 398-400, raise questions about the origin of the historical concept of human races in light of recent genetic and anthropological findings. (More on this below) The remainder of this excerpt is included to give some history of the development of the concept of human races. This reading is here to give background for thinking about what race means in the context of the following papers. Keep it in mind during the discussion of the papers below.

What is the origin of the use of the word "race?" How has race been used in biology? Is it used today in biology? What are the varying definitions of race in these papers. Is it a valid term to use for human populations? How do you define race or would you? Why is it useful to define race? These questions are relevant to each of the papers in this session.

3. Contemporary efforts to use human genetics to distinguish "groups"

M.W. Feldman and R.C. Lewontin. "Race, Ancestry and Medicine" in **Revisiting Race in a Genomic Age**, eds. B.A. Koenig, S.S.-J. Lee and S.S. Richardson. New Brunswick, NJ. Rutgers University Press. pp. 89-101 (2008).

As you will note, Feldman is one of the co-authors of the Rosenberg et al. paper. When you read this Feldman and Lewontin paper, did the approach become clearer? Please be prepared to describe how you think it works. Consider whether you think that the clinality of classifying groups has implications for making claims of biological races. Are the authors' arguments convincing?

Stop and think, at this stage of the reading, what do you think about the concept of biologically defined races.

N.A. Rosenberg et al., Genetic structure of human populations. *Science* **298**:2381-2385 (2002). S. Tishkoff et al. the genetic structure and history of Africans and African-Americans. *Science* **234**:1035-1043 (2009). (A PODcast interview with Tishkoff for a pretty clear description of the study can be accessed at the May 22, 2009 *Science Magazine* where the article was published. Maybe the link below will work.)

<http://www.sciencemag.org.ezp-prod1.hul.harvard.edu/cgi/content/full/1172257/DC2>

These two papers are difficult to read and I don't want you to spend a lot of time on them. I hope that by reading the Feldman and Lewontin paper first, you will have a general technical sense of how Rosenberg et al. and Tishkoff et al. approach these questions.

For our discussion purposes, note that in the Rosenberg paper, arguments are made for there being 5 more or less equally distinguishable groups that one can divide the world's

populations into. But, the Tishkoff paper can be interpreted to mean that there are approximately 18 groups (4 of the original and 14 instead of one for Africa). This is illustrated by Figure 1.

For these papers, what questions and problems have generated this scientific effort? Does the historical/philosophical analysis we have gone into in the first three sessions have any applications here? Gould's "Mismeasure of Man" critiqued research that sought to differentiate groups biologically. Could a similar critique be made of this science? Why or why not?

Note that the papers don't use the word race. Why? Does the science establish that there are genetically distinct races or geographically defined groups? Distinct in what way? What might these differences be related to?

Do you think that there are any significant social concerns about this research or its suggested implications? If you think that there may be some unwanted consequences or misuse of this research, how could they be avoided? Who might help prevent such consequences?

4. An anthropologist observes the research

D. Fullwiley. The Biological Construction of Race: 'Admixture' Technology and the New Genetic Medicine. *Social Studies of Science* **38**:695-735 (2008).

Anthropologist Duana Fullwiley spent a number of months in two labs that were doing 1)genetic and ancestry research and 2)research on racial differences in disease susceptibility or response to pharmaceuticals. What does she mean by "Biological Construction of Race?" Early on she states that "the methodology deployed..... is itself designed to bring about a correspondence between [race and DNA]...." Do you think that the title and this statement in particular are justified by her observations reported in the article? Do you see anything problematic with the treatment of racial categories in this lab as described here? Do you see any problems with the science itself or the assumptions going into it? Do you consider the KKK interest of concern? Does it make any difference for the KKK and its impact whether they can use scientific arguments?

5. Guidelines for "race" research

S.S.-J. Lee et al. The ethics of characterizing difference: guiding principles on using racial categories in human genetics. *Genome Biology* **9**:404 (2008).

I would like us to go through each proposal and discuss its worth or lack thereof.. Would you eliminate any of them? Would you add any?

Microbiology 213
February 25, 2010

How science may influence social norms: from the scientific article to the media to social policy?

P.D. Evans *et al.* *Microcephalin*, a gene regulating brain size, continues to evolve adaptively in humans. *Science* **309**:171-1720 (2005).

M. Balter. Are human brains still evolving? Brain genes show signs of selection. *Science* **309**:1662-1663 (2005).

For this session, I have only the two readings above. However, what I would like you to do is to search the Web and find and read as much material as you can that relates to this study: discussions of this article and follow-up studies to this one-articles in scientific journals, in the media, in blogs, etc., etc. In addition to search programs such as PubMed, Google, etc., use Lexis-Nexus and any others you can think of. Putting together all of this material, consider the following questions:

What do you think of the scientific quality of the study, including the conclusion that one allele was selected for?

Do you think that the speculation on the historical/evolutionary basis for selection in the *Science* article is warranted? Please come with your argument for a yes, maybe or no answer to this question? Is this material handled by the authors in a way that fits with the guideline paper for race and genetics research that we read as the last reading last week?

How well do you think that *Science Magazine* handled the story in the Balter report of it?

How well did media coverage of the *Science* article represent what was presented in the article? Did they cover it accurately, misrepresent it, exaggerate, or totally distort it?

How well did the media cover subsequent scientific articles that followed up on the original *Science* article? Does it make any difference or not? Why? Does it say anything about reporting science?

Did the media or other commentaries on the article draw any social implications of the study? Are they valid? If you think that some of the speculation by the scientists or others is problematic, what should be done about it? Or, if it concerns you, if you had been a co-author, what could you have done to prevent such misrepresentation?

The name Rushton (J. Philippe Rushton) should come up in your searches. Do a little research on him and see if it adds or not to your thinking about aspects of this story.

Why did this article attract media attention? Consider all of the steps from the scientific journal to the public that might have contributed to this attention. Do you know how scientific journals interact with the media and with what guidelines?

(If you want to see a somewhat recent article on the status of the hunt for genes for intelligence, read Carl. Zimmer. The Search for Intelligence. Scientific American pp. 68-75 (October, 2008).)

Microbiology 213
Women, Men, Gender, Sexuality and Science
March 4, 2010

Although this looks like a lot, much of it is relatively light reading. I would like you to take advantage of that to think fairly hard about the issues involved. The first set of readings continue, hopefully, our discussion of how science is presented by scientists, by the media and what social consequences there might be. It may be a prelude for questions to the journalist on the following week.

1. C.P. Benbow and J. Stanley. Sex differences in mathematical ability: fact or artifact. *Science* **210**: 1262-4 (1980)
G. Kolata. Math and sex: are girls born with less ability? *Science* **210**:1234-1235 (1980)
D.A. Williams and P. King. Do males have a math gene? *Newsweek*, Dec. 15, 1980, 73
---The gender factor in math. *Time*, Dec. 15, 1980, 57
Two articles from the NY Times, one weekday and one on the following Sunday.
J. Beckwith. Gender and math performance. *J. Education (B.U.)*. **165**: 158-175 (1983).

These papers cover a controversy that erupted in 1980. The comments of President Larry Summers of Harvard in 2005 revived the controversy, with discussants sometimes even referring back to this study.

Read carefully and critically the argument presented by Benbow and Stanley? Go through their reasoning. Do you see any flaws? What are they concluding?

Think about the steps from their article to the *Science* article by Kolata to the news magazine and newspaper articles, including the headlines? Why do you think the Benbow and Stanley article received so much publicity? Was it warranted? Is the reporting accurate? If not, who's at fault?

Can you think of aspects of this story that reveal or suggest any motivation, conscious or unconscious of the scientists?

With my article, do you find the criticisms valid? All? Any? Is it accurate to say that the science is invalid? Does the finding of biological differences really have no implications?

2. A long shelf-life for a 1980 paper
R. Monastersky. Primed for Numbers. *The Chronicle of Higher Education*. March 4, 2005.
L. Guiso, F. Monte, P. Sapienza and L. Zingales. Culture, Gender and Math. *Science* **320**:1164-1165 (2008).
The debate continues with a connection to the Larry Summers incident.

But how do these readings affect your view of the 1980 paper? Does it raise any questions about their assumptions?

Do you think that any of the consequences of the publicity for the original study are of concern? If so, how might things have proceeded differently, starting perhaps with the researchers?

Professor Alan Dershowitz at Harvard Law School, in response to the recent debates, has stated that he was going to be teaching a course called "Taboo" that would discuss the science of sex differences (presumably among other things). Should the science be Taboo? Is that what the critics are saying? Should any science be Taboo?

3. S. Blaffer Hrdy. The human element in the study of human nature. Reed Alumni Bulletin. 1983.

J. Knight. Sexual stereotypes. *Nature* **415**:254-256 (2002).

The Hrdy paper presents an argument about how the ground rules of a science change because of external social forces. Does this case seem relevant to our own science or peculiar to a science that treats an issue related to human behavior? Blaffer Hrdy is a primatologist/sociobiologist who clearly recognizes the social influences on science, including her own.

Obviously the debate continues. Does Knight's article seem neutral, biased, etc?

How much do you think we can rely on animal (e.g. primate) studies to inform us about human behavior?

4. B.S. Mustanski et al. A genomewide scan of male sexual orientation. *Hum. Genet.* **116**:272-278 (2005).

A. Fausto-Sterling. Frameworks of Desire. *Daedalus*, Spring 2007 47-57.

E. Marshall. Sex on the Brain. *Science* **257**:620-621 (1992).

D. Hamer and M. Rosbash. Genetics and Proposition 8: Human sexual orientation has deep biological roots. Op-Ed piece in the *LATime*. Feb. 23, 2010.

The first is an article that presents a search for genes correlated with homosexuality. Read carefully for the assumptions upon which the research is based. Do you know what a LOD score is? What a significant LOD score is for this kind of study? As with article like this we have read before, I don't expect you to have to understand every last detail of their paper.

Fausto-Sterling is criticizing the assumptions of the Mustanski paper. Do you agree with her critique? Do you understand what she is proposing for an alternative approach to the origins of sexuality? Is it an improvement?

The article about bias (conflict of interest) focuses on the work of Simon LeVay who is referred to in the Mustanski paper. At that particular time, three papers, including LeVay's came out that presented different lines of evidence for a biological basis for homosexuality in males. In all three cases, either the main researchers or one of the main researcher was gay himself and each has argued that finding a biological basis for homosexuality would improve the civil rights

situation of gays. This is why the issue of bias came up. Do you think that they are right about the benefits of this research? (Note that this case is the opposite of what we read about in the situation of race or women and math where biology was being used to suggest inequalities.)

Finally, the very recent LATimes Op-Ed piece adds to the discussion of the relevance of biology to the establishment of social norms.

Further Reading if you're interested:

J.S. Hyde et al. Gender similarities characterize math performance. *Science* **321**:494-495 (2008).

Authors claim that girls and boys score just as well at math.

P.A. Lawrence. Men, Women and Ghosts in Science. *PLoS Biology*. **4**:e19 (DOI:10.371/journal.pbio.004019) (2006).

B. Barres. Does gender matter? *Science* **442**:133-136 (2006).

This is sort of a debate between the two authors. I don't think anyone is truly arguing that there are no relevant biological differences between men and women. But it is over what are the differences are, how much we know about them, and how any knowledge about them should influence social policy.

Two books you might be interested in:

S. Blaffer Hrdy. *The Woman that Never Evolved*. Harvard Univ. Press. A quite readable account of primatology and the male influences on research. Blaffer Hrdy's sociobiological approach comes through quite strongly, and although I disagree with aspects of that approach when applied to humans, the book is still fascinating.

A. Fausto-Sterling. *Myths of Gender: Biological Theories about Men and Women*. Basic Books. 1985. Revised in 1992, issued in paperback. A comprehensive critique of such theories, including most of the issues discussed in this session. Also includes Fausto-Sterling's view of an alternative science.

Microbiology 213
Social Issues in Biology
March 11, 2010 (Week 7)
No class on March 18, undergrad vacation week

Science and Journalism: From the Scientific Journal to the Public.

Guest: Carolyn Johnson (Boston Globe science/medicine reporter)

Carolyn (if there is no breaking story at the Globe) will arrive at the beginning of the class and stay until the break. **After reading the materials below, PLEASE COME PREPARED WITH QUESTIONS YOU WOULD LIKE TO ASK HER.**

I. Articles on Science Journalism.

- 1) J.A. Winsten. Science and the Media: The Boundaries of Truth. *Health Affairs*, Spring, 1985. pp. 5-23.
- 2) V. de Samir et al. Press Releases of Science Journal Articles and Subsequent Newspaper Stories on the Same Topic. *JAMA* 280:294-5 (1998).
- 3) T.M. Bubela and T.A. Caulfield. Do the print media “hype” genetic research? A comparison of newspaper stories and peer-reviewed research papers. *Canadian Medical Association Journal* **170**:1399-1407 (2004).
- 4) C. Condit commentary on Bubela and Caulfield article. *CMAJ* **170**:1415-1416 (2004).
- 5) R. Weiss. Behavioral Genetics and the Media. in *Wrestling with Behavioral Genetics: Science, Ethics and Public Conversation*, eds. E. Parens, A.R. Chapman and N. Press. Johns Hopkins Univ. Press. pp 309-326 (2006).
- 6) C. Condit. How geneticists can help reporters get their story right. *Nature Reviews Genetics* 8:815-20 (2007).
- 7) H. P. Peters *et al.* Interactions with mass media. *Science* **321**:204-205 (2008).
- 8) _____ Filling the Void. *Nature* **458**: 260 (2009)
- 9) G. Brumfiel. Supplanting the old media? *Nature* **458**:274-277 (2009)
- 10) S. Jaschik. New Outlet for Sharing Science. In *Inside Higher Education* (Web). Sept. 15, 2009.

Read these in preparation for Carolyn Johnson’s visit and for discussion in the second half of the class. It is possible that much of this discussion may not be relevant if the communication of science to the public changes very

much from what it has been recently. This question is raised particularly by the last three readings.

The issues here are not simply about the role of the science journalist, but about the dynamics of competing interests: editors, journalists and scientists. Consider the following questions, as you read these articles:

1. From readings in some of the course's sessions, we have seen how science is transmitted to the public by a series of steps. Recall the coverage of the Microcephalin story and the boys, girls and math study. If you think there are problems in accurately 1)communicating and 2)reporting such stories, where does the blame fall?
2. Did these readings change any of your views about science reporting? How?
3. What is your impression of science journalism today?
4. What are the goals of a science journalist and should they be any different? What are the constraints on science journalists? How do the goals and constraints conflict?
5. What should and do scientists expect from the science journalist? How can scientists best achieve these goals? Are these goals valid? When and why do scientists want coverage of their work?
6. What are the consequences of misrepresentation of scientific findings? Are they serious or not too serious? Who is responsible for misrepresentation? Scientists, journalists, editors, the public?
7. Any solutions to any of the problems discussed? Some have suggested reporting science more as "trends in research" rather than breakthroughs. Is that a good idea? Is it possible? How might scientists better handle communication with journalists? How can journalists better survey scientific opinion on a particular study? Is that the problem?
8. Does genetics raise particular problems in communication of science to the public? What do you think of the suggestions made with regard to genetics reporting by several of the articles?
9. Who writes the headlines on science articles?
10. Can you relate the issues in this session to any of the analysis of Kuhn or of readings we have done in subsequent weeks? Given perhaps a better appreciation of science and its development, can you suggest different ways for the journalist and scientist to approach the reporting of science?
- 11. Given the rapid decline of newspapers and, among other things, the contraction in science news, perhaps the most important question is how will the public learn about science in the future? Blogs, university press releases,? Come in with your thoughts on these questions and in whether any the alternatives are better, worse or the same.**

**Microbiology 213
Social Issues in Biology
March 25, 2010**

The Social Impact of Genetic Testing

Some of you may in your thesis work or later on be involved in the identification of genes or makers correlated with hereditary diseases or susceptibilities. These readings illustrate potential societal end-points of the availability of the genetic tests that result. Human genome sequencing and mapping has allowed the development of genetic tests that detect susceptibility to many genetic diseases and conditions. It has also led to widespread discussion of the potential social impact of the introduction of genetic tests into the clinical setting. Issues such as privacy, discrimination, stigmatization and availability of health insurance have been discussed. How informed does the basic science researcher have to be in this area? What role should geneticists play in these discussions?

For some of today's readings, I am trying something new. For the sets of readings 2, 3 and 4, I am asking specific people to argue different positions on the issues involved. Of course, I want everyone to read everything and participate in all of the discussions.

Readings:

1. Excerpts from Rayna Rapp's Testing the Women, Testing the Fetus, Routledge, NY. 1999. Pp. 3-8; 66-93. The file contains many more pages. YOU NEED READ ONLY THE ASSIGNED PAGES (but can read more if you want).

The Rapp readings are in two parts (two PDF files). Rapp is an anthropologist who has spent many years observing and participating in interactions between pregnant women and their families and medical professionals, mainly genetic counselors. Her experiences reveal much complexity and diversity in the population in dealing with genetic information. There are a variety of issues to think about here: 1)Should genetic counseling be non-directive- can it be non-directive? 2)How does different cultural/ethnic/class background influence attitudes towards screening and reproductive decisions? 3)How is normality defined or should it be? 4)How do we deal with issues of science literacy in areas like this where scientific information is being communicated?

2. A. Asch. Prenatal diagnosis and selective abortion: a challenge to practice and policy. Am. J. Public Health. 89:1649-1657 (1999). PLUS T. Lee. You probably won't like James Watson's ideas about us. Ragged Edge. Mar/Apr. p. 16 (1998).

For these readings, I would like Dana Berry to offer a defense of Asch's position; for Matt Gerding to offer a critique of it and support of Watson's position (but not in the same tone) since he is touching on issues that people can take seriously; and Ben Morris to offer his commentary on the issues. For the critique of Asch, you can also introduce your own ideas.

Rapp, in her book, touches on issues of disability. The Asch article raises questions that arise from the development of new genetic tests, presenting a significant point of view within the community of people with disabilities. Does this influence your thinking about prenatal testing, etc.? Asch is trained in social psychology. Do you think Watson's ideas may be widely shared or more acceptable if less inflammatory language were used?

3. Beckwith, J., and Geller, L.N. Genetic discrimination: anticipating the consequences of genetic discovery. in: N.F. Sharpe and R.F. Carter: *Genetic Testing: Care, Consent, and Liability*. J. Wiley and Sons. pp. 146-156 (2006). A. Harmon. Insurance fears lead many to shun genetic tests, NYTimes. Feb. 24, 2008 plus response letters; C. Erwin. Legal update: living with the Genetic Information Nondiscrimination Act. *Genetics in Medicine*. 10: 860-873 (2008); B. Gruber; M. Rothstein, articles on the GINA law from the magazine *Gene Watch* (2009); (you don't have to read the Slaughter article). C. Tuna. Wellness efforts face hurdles. *The Wall Street Journal*. Feb. 1, 2010; .

For these readings, I would like Francis Deng to offer an argument that the GINA law is a good thing; for Steve Hershman to offer an argument that it has lots of problems with it and maybe is a bad law; for Matt Schwartz to offer a commentary on the arguments that have been made. If you have ideas of your own about the law on either side, mention them also.

The Beckwith-Geller article gives a history, perhaps biased, of the origins of the concerns about genetic discrimination and speculates about the role of the ELSI program. The NYTimes article describes an "ironic" result of the availability of so many more tests. Do you agree that people have to be protected against genetic discrimination in insurance and other areas and problematic genetic tests? How? Quite recently, the GINA law was passed. Does it seem like it will solve the problem, if you think there is one? The articles raise some of the benefits and some of the problems with it, both concerning its impact positively and negatively. What other solutions are there?

4. S. Lumenello. Perfection Complex: an interview with political philosopher Michael Sandel. *Colloquy* (Harvard GSAS Alumni Quarterly) Fall, 2007. pp.2,3,10,11; C. Elliott. The mixed promise of genetic medicine. *NEJM* 365:2024-2025 (2007).

For these readings, I would like Elena Fradkov to argue for Michael Sandel's position; for Jeffrey Low to argue Elliott's position or against Sandel's position; and for David Shore to offer a commentary on the arguments made. (These are not really opposing arguments, but do offer different arguments.) You may also add any thoughts you have about the issues that neither author mentions.

These two pieces talk about the future impact of genetics and genetic testing, although from very different perspectives and touching on different issues. I thought it would be particularly interesting to sum up this session with a discussion of what the future looks like. Sandel is more worried about how society will handle human genetic information. Elliott is, in part, responding to Sandel. Do you agree with either of their views? Do you think there is anything to worry about? If so, come prepared to talk about those issues or to argue why you don't agree with either of the authors.

Microbiology 213
Social Issues in Biology
April 1, 2010

The Genomic Information Industry
Privacy, Discrimination, and Self-knowledge?

Recent years have seen the emergence of an industry providing direct-to-consumer (DTC) genetic testing services. Marketed and offered directly to individuals, and covering a broad range of phenotypic trait loci (with both potential medical and non-medical application), these broad genome scans stand in contrast to the limited genetic testing that had been performed for certain validated pathogenetic loci in the clinical setting. These companies' products vary widely in cost, the genetic tests they provide, and the interpretive information they offer. The emergence of these companies has ignited a debate over the validity and accuracy of the tests with regards to phenotypic correlations; whether or not they inappropriately offer substantive medical information without the involvement of a physician or genetic counselor; issues of privacy, discrimination, and the potential for misuse of genomic information; and what is appropriate regulatory oversight and restrictions on such tests. The readings address, and we will discuss, some of these issues.

Direct-to-consumer genetic testing

Direct-to-Consumer Genetic Testing Companies, updated 3/9/2010. Genetics and Public Policy Center.

This list is provided just to give you a sense of the number of DTC genetic testing companies, and various tests and services they provide.

Also explore online how one prominent DTC genetic testing company, 23andMe, markets its tests and how the genetic information is presented: <http://www.23andme.com>

Caulfield T. Direct-to-consumer genetic testing: good, bad, or benign? 2010. *Clinical Genetics*. 77:101-105.

This short perspectives piece gives an overview of the industry, as well as some of the issues discussed in the ongoing debate.

Ng PC, et al. An agenda for personalized medicine. *Nature*. 2009. 461:724-6.

Venter *et al.* compare the results of DTC genetic testing companies on five individuals. What do you think about the findings of this comparison? What do you think, specifically, about the recommendations that they make?

Varied Reactions to the Regulation of DTC Genetic Testing

When it was reported that the New York and California Departments of Public Health had sent regulatory letters to DTC genetic testing companies challenging some of their practices, a public discussion regarding DTC genetic testing was ignited. Reactions were mixed. The reading below includes two short editorials in the medical/scientific literature as to whether DTC genetic testing is appropriate and to whether a physician or genetic counselor should be a gatekeeper to genetic testing, as well as two short online responses from individuals arguing the limitation of consumer access to genome analysis is an invasion of personal medical autonomy and circumscribes the right to self-knowledge. Which arguments do you find persuasive? Why? Come prepared to argue using information in these readings, or your own ideas, whether or not this industry ought to be better regulated or not; whether consumers access to genetic information with medical import should be mediated by a healthcare provider or not. Please also be prepared to argue both for and against having personal access to different kinds of testing: i.e., disease genetic risk testing, recreational genetic testing (e.g., ear wax type), and ancestry genetic testing.

Editorial: In need of counseling? *Nature Biotechnology*. July 2008. 26(7).

Editorial: Direct-to-consumer genetic tests: flawed and unethical. *The Lancet Oncology*. Dec 2008. Vol. 9.

Goetz T. “Attention, California Health Dept.: My DNA is My Data” *Wired Science Blog*. Accessed at <http://www.wired.com/wiredscience/2008/06/attention-calif/>

Rowe A. “Top 10 Reasons that Regulators Should Not Hinder Genetic Testing.” *Wired Science Blog*. Accessed at <http://www.wired.com/wiredscience/2008/06/top-10-reasons/>

Personal Genomes and Open Consent

Wade N. Disease cause is pinpointed with genome. *New York Times*. 10 March 2010.

MacArthur D. Disease hunting with whole genome sequences: the good news, and the bad news. *Genetic Future Blog*. Posted online 10 March 2010.

These two short news articles (one print news and one blog) discuss recent successes in identifying disease loci by whole genome sequencing. How might whole genome sequencing change the way people think about genetics and risk? Do these articles give differing takes on the two studies discussed; and if so, what different pictures do they paint? Does whole genome sequencing represent the promising future of genetic discovery?

Lunshof JE, Chadwick R, Vorhaus DB, Church GM. From genetic privacy to open consent. Nat Rev Genet. April 2008.

Church *et al.* discuss a new model of Open Consent regarding genetic information. They argue that genetic information should be treated like any other information with regard to privacy. What are the principles of Open Consent? What does open consent with regards to genetic information require in order to ensure it is effective and substantially informed? Is genetic information different than other information? Other medical information? (i.e., is “genetic exceptionalism” warranted in a discussion of privacy of genetic information?). What do you think about this form as a model of consent? What do you see as its essential elements? Is ensuring substantially informed consent with regards to lack of privacy, potential for discrimination, and/or misuse of personal genetic information sufficient to justify treating personal genomes as public information? Why? Would anything else just be paternalism?

Further Optional Reading:

<http://www.personalgenomes.org/>

Familiarize yourself with the project goals and participation requirements of the Harvard-based Personal Genome Project, which is using the “Open Consent” model.

McGuire AL, Burke W. An Unwelcome Side Effect of Direct-to-Consumer Personal Genome Testing: Raiding the Medical Commons. *NEJM*. Dec 2008. 300(22):2669-2671.

Pollack A. Consumers slow to embrace the age of genomics. 2010. *New York Times*. 19 March 2010.

van Dijk S, et al. Putting it all behind: Long term psychological impact of an inconclusive DNA test result for breast cancer. *Genetics in Medicine*. Oct 2008. 10(10):745-750.

Vorhaus D. Evaluating the NIH’s new genomic testing registry. Genomics Law Report Blog. Posted online 18 March 2010.

Microbiology 213
April 8, 2010
Genetics, the Law and the Criminal Justice System

In addition to discussing the readings, we will watch a portion of the French documentary, “Tracked Down By Our Genes,” which brings together some of the issues you have discussed previously (race, ancestry, and genetic testing; the genome sequencing industry), and issues that will be discussed today (behavioral genetics and DNA forensics).

Part One: Crime and Behavioral Genetics

These readings examine a debate regarding the field of behavioral genetics and its intersection with the criminal justice system.

J. Beckwith, *Making Genes, Making Waves: A Social Activist in Science* (Harvard University Press, Cambridge, 2002), Chapter 8. “The Myth of the Criminal Chromosome,” pp. 116-134.

Why did the XYY story gain ground so quickly? Are there other examples of this? What, if anything, could have been done or can be done to arrest this type of inaccurate dissemination? When, if ever, is it appropriate to stop a scientific study?

Caspi A. et al. (2002) Role of genotype in the cycle of violence in maltreated children *Science* 297, 851-4.

Z. Prichard et al. (2008) No evidence for interaction between *MAOA* and childhood adversity for antisocial behavior. *American Journal of Medical Genetics* 147, 228-32.

Compare the findings presented in Caspi et al. (2002; the first study presenting a gene-environment interaction for criminal/antisocial behavior with maltreatment) and that of Prichard et al. (2008; the largest study to date attempting to replicate the Caspi findings). What do you think of the conclusions and the recommendations of the Caspi study? Do they follow from the findings? Are they appropriate? What are some of the possible reasons for the dramatically different findings presented in the two studies? Methodological? Statistical? Cultural? What are the implications?







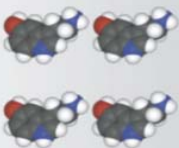




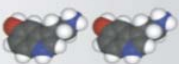




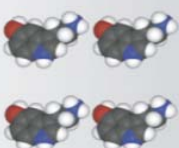



C. Morris, A. Shen, K. Pierce, J. Beckwith. 2007. *Deconstructing Violence. Gene Watch* Volume 20 Number 2, pp. 3-10, March - April 2007.

Are the premises and methods investigating links between behavior and genetics sound? How does social context inform this study? If the Caspi et al. conclusions were to become well established, what do you think the social implications would be? Would genetic screening be a good idea? Who should be screened? How should the screening information be used?

W. Bernet et al. (2007) Bad nature, bad nurture, and testimony regarding MAOA and SLC6A4 genotyping at murder trials. *Journal of Forensic Sciences* 52(6): 1362-71.

How is MAOA genotyping (along with SLC6A4 genotyping) being used in these legal cases? What kinds of problems occur when science enters the courtroom? Does it seem from the cases discussed here that the “gate keeping” mechanism is working? Does the science substantiate usage in court? What is the nature of a scientist’s responsibility for the use of science in the courtroom?

Spend a couple of minutes looking online for examples of MAOA violence/criminality/aggression research making its way into more popular literature by searching Google Books, or other online sources. Bring a couple examples of what you find.

MAOA genotype	Developmental 5-HT	Circuit-level effects	Early-life experience	Behavioral outcome
 ACCGGCACCGGCACCAGTACCCGACCAAGT MAOA-H				
 ACCGGCACCGGCACCAGTACCCGACCAAGT MAOA-L				
 ACCGGCACCGGCACCAGTACCCGACCAAGT MAOA-H				
 ACCGGCACCGGCACCAGTACCCGACCAAGT MAOA-L				

TRENDS in Neurosciences

Figure above from Feb. 2008 *Trends in Neuroscience* article on “MAOA and the neurogenetic architecture of human aggression” depicting MAOA genotype and early-life experience in “predicting adult antisocial behavior.” (Buckholtz and Meyer-Lindenberg). After doing the Part One readings, what are your reactions to both the image and quotes above?

Part Two: DNA Forensics and Databases

This section deals with the use of genetics as a law enforcement tool. Again, consider both the scientific merit of the technologies as well as how the technologies interact with existing institutions and social contexts.

Rosen J. 2009. “Genetic Surveillance for All?” Slate.com March 17, 2009

Seringhaus M. “To stop crime, share your genes.” New York Times. March 15, 2010. And Letters to the Editor in reply.

These two articles discuss the expansion of DNA databases, which will now include the DNA of anyone arrested for a federal offense (regardless of whether one is guilty or convicted). The Rosen article also discusses “familial searching.” Several states are moving in the direction of increased inclusion and wider DNA drag nets. Does this concern you, or should it only concern those who are worried about being caught for a crime? Think about existing disparities in law enforcement. How do DNA databases and familial searches further amplify these disparities? Are there ways that these disparities could be addressed so as to make a DNA database “fair”?

Rothstein, Mark, and Meghan Talbott. 2006. The Expanding Use of DNA in Law Enforcement: What Role for Privacy? *J. Law, Medicine & Ethics* 34:153. (17 pages)

How convincing are proposals for expanding DNA databases? What beliefs underlie these proposals for expansion? How do you evaluate “Indirect Searches” and “Low-Stringency Searches”? Finally, do you think that in a post Facebook/Myspace age, have privacy norms changed? Why or why not?

Microbiology 213
Cloning, Research, and Future Persons
April 15, 2010

L. M. Guenin

Readings

We will discuss all the issues raised in the following readings as time permits. If, as you read, you find yourself strongly disposed toward one argument or point of view, also ask yourself how you would construct arguments for an opposing view.

1. Martha Nussbaum and Cass Sunstein, *Clones and Clones* (Norton, 1998)
 - a. Introduction, pp. 11–14.
 - b. Stephen Jay Gould, ‘Dolly’s Fashion and Louis’s Passion,’ pp. 41–49.
2. Louis M. Guenin, *The Morality of Embryo Use* (Cambridge University Press, 2008), pp. 181–213.

The term ‘epidosembryo’ occasionally used here denotes an extracorporeal embryo that, as of or after its creation, has been donated by its progenitors for use in medical research and therapy on the condition that intrauterine transfer shall never occur. Nonreprocloning is one variety of embryonic stem cell research that creates and uses epidosembryos. We shall talk primarily about reprocloning, other ways of designing offspring, and their moral and societal implications.

3. Eric A. Posner and Richard A. Posner, ‘The Demand for Human Cloning,’ in Nussbaum and Sunstein, pp. 233–261.

Consider the cogency of the authors’ scientific reasoning concerning demand. Comparing their view and that in 3. above, what do you think is a plausible prediction of demand for reprocloning?

4. Barack Obama, final examination, Constitutional Law III, and answer memorandum, University of Chicago Law School, fall 1997.

You need not be concerned with mastering the details of the legal reasoning here. Rather this will serve to introduce the framework of present law. Do you think that, if someday reprocloning becomes relatively safe, the state should prohibit it?

Microbiology 213
Scientists in Society
April 22, 2010

Please buy the book “American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer by K. Bird and M. Sherwin., Knopf, New York (2005).

1. From “American Prometheus,” read the short preface and Chapters 13-26. Then read ONLY Pages 31-35 of the short Oppenheimer biography in the PDF file Oppenheimer.pdf (from a University of California, Berkeley Website, <http://ohst.berkeley.edu/oppenheimer/exhibit/>) which gives a brief description of his loss of security clearance.

I recommend that, when you’ve got a chance, you read the entire book. In addition to what you’ve read for this session, the book presents a fascinating history of the ferment and excitement in physics in the 1920’s and 1930’s. Overall, the book also presents significant parts of the social and political history of the country during much of Oppenheimer’s life. It is a very rich book.

Be prepared to recount the part of Oppenheimer’s history in these chapters. More broadly, consider the role of different scientists in discussions of morality, ethics, politics of this science. Notice the discussions among scientists about their concerns over the development of atomic weapons. Some refused to participate, others participated in such discussions while they were doing the research, others spoke out and suggested sharing atomic secrets with the Russians. Note how many reacted after the use of atomic weapons in Japan. What role should scientists play, what role did they play, what were the effects of their actions, etc.? (On page 549, the authors state “With Oppenheimer’s defrocking [1954], scientists knew that in the future they could serve the state only as experts on narrow scientific issues.”) In Chapter 24, what do you think of Oppenheimer’s views on the importance of science.

What were the different attitudes of scientists towards development of atomic weapons?

What did they do about it?

How and when did their discussions on ethics start?

Did they have special knowledge that made it reasonable for them to try to influence policy? Should the Russians have been invited in?

What do you think of the battle over secrecy where “the rules of science had trumped the principles of military security.”

What do you think of Bohr’s conception of “the communitarian nature of scientific inquiry?”

Do you get the occasional sense of the scientists’ enthusiasm for the development of the bomb purely as a scientific problem? Is it understandable or disturbing?

Are there differences in the morality of what Oppenheimer, Bohr, etc.,and Heisenberg did?

2. **J. Conant. Last of the outspoken scientists. Boston Globe, April, 2005.**
J. Rotblat. A Hippocratic oath for scientists. Science 286:1475 (1999).

These readings connect to two of the people who are characters in the Oppenheimer book. What role did they play? The Conant article follows the death of Phillip Morrison, who was part of the Manhattan Project. Do you agree with the thrust of her article? What do you think of Rotblat's proposal?

Microbiology 213
April 29, 2010

Social Activism in Science: The Recombinant DNA Debate and Science Activists

I. Read pages 1-67; 83 to the middle of page 90 of J. Beckwith “Making Genes, Making Waves: A Social Activist in Science” Harvard University Press (2002).

Here, I've been complaining all semester about scientists going to the media, holding press conferences, etc and contributing to misrepresentation of science. Did we (me and my colleagues) do the same thing?

The last section on the situation in my lab during this period may give a sense (perhaps) extreme of what the societal environment was like and how it invaded the lab. Any comments?

Please come prepared with your comments, criticisms and any questions you want to ask me.

II. The Recombinant DNA Controversy

P. Berg et al. Potential biohazards of recombinant DNA molecules. *Science* 26 July, 1974, p. 303

V. K. McElheny. “Watson and DNA: Making a Scientific Revolution.” pp. 220-237. Perseus Publishing, Cambridge (2003).

N. Wade. Genetics: conference sets strict controls to replace moratorium. *Science* **187**:931-935 (1975).

P. Berg and M. F. Singer. The recombinant controversy: Twenty years later. *Proc. Natl. Acad. Sci. USA*, **92**:9011-9013 (1995).

D. Nelkin. Threats and promises: negotiating the control of research. *Daedalus* Spring, 1978 191-210.

This is an instance where leading scientists got together and proposed a moratorium on the use of a particular research technique (recombinant DNA) and ultimately came up with guidelines for carrying out the research. It involves several different perspectives among scientists. Among those who first proposed the moratorium, some continue to point to it as an important instance of social responsibility, while others think it was a mistake. Other scientists felt that it was an elite group of scientists who established the moratorium and guidelines and there should have been more public involvement. Finally, some scientists wanted the discussions to include the prospects of human genetic engineering (e.g.me). In some cases, the public also got involved in discussions of the issues. The debates were pretty fierce at times as you may sense from the excerpt from the biography of Watson. These readings may give you a sense of the different perspectives in the controversy. The calling of the Asilomar Conference likely reflects the environment in which activism among researchers and science students began to flourish in the late 1960's.

There are a number of important questions that arise. There are those who argue that it is a mistake and a dangerous precedent 1)to stop a scientific project that may provide great societal benefits and 2)to air the issues publicly. What do you think?

III. Scientists who acted: Why?

Arthur Galston. Science and social responsibility: a case study. *Annals of the NY Acad. Sci.* **196**:223-235 (1972)

M. Meselson. Averting the hostile exploitation of biotechnology. *CBWCB* **48**:16-19 (2000)

American Society for Cell Biology. Statement on Public Service Award to Matt Meselson, (2002)

T.O. Baldwin. Engaging the Public. *ASBMB Today*. April 2010.

S. J. Gould. Pp. 351-353 in *The Mismeasure of Man*.

These are four instances of scientists who became concerned about certain issues and, by the very nature of the issues, took very different approaches. Our discussion this past week about a Hippocratic Oath for scientists included comments about the difference in being precise comparing a Doctor's Oath vs. a Scientist's Oath.

What do you think of Gould's praise of "debunking?"