IN THE UNITED STATES DISTRICT COURT FOR THE MIDDLE DISTRICT OF PENNSYLVANIA

TAMMY KITZMILLER, et al

: CASE NO.

v. : 4:04-CR-002688

:

DOVER AREA SCHOOL DISTRICT, :

et al

TRANSCRIPT OF PROCEEDINGS
BENCH TRIAL

AFTERNOON SESSION

CROSS EXAMINATION OF KENNETH MILLER, Ph.D.

BEFORE: HON. JOHN E. JONES, III

DATE: September 26, 2005

1:47 p.m.

PLACE: Courtroom No. 2, 9th Floor

Federal Building

Harrisburg, Pennsylvania

BY : Wendy C. Yinger, RPR

U.S. Official Court Reporter

APPEARANCES:

ERIC J. ROTHSCHILD, ESQUIRE WITOLD J. WALCZAK, ESQUIRE STEPHEN G. HARVEY, ESQUIRE RICHARD B. KATSKEE, ESQUIRE For the Plaintiffs

PATRICK T. GILLEN, ESQUIRE RICHARD THOMPSON, ESQUIRE ROBERT J. MUISE, ESQUIRE For the Defendants

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CROSS EXAMINATION

BY MR. MUISE:

- Q. Dr. Miller, as a sympathetic Red Sox fan, I can't help but ask you whether you believe the Red Sox won the world series because of supernatural causes. And I quess that would be reversing the curse of the Bambino?
- A. I think it's entirely within the realm of possibility, but as I indicated earlier, it's not a scientific hypothesis. And perhaps we'll get a chance to see this year in terms of how things turned out.
- Q. You think it also could have probably had something to do with batting averages, on base percentages, pitching statistics, fielding percentage, for example?
- A. And you forgot plain dumb luck. And I certainly agree with that.
- Q. That would be logical to infer that they perhaps may have won based on observable empirical facts?
- A. Well, they certainly did win on the basis of observed empirical facts in that, for four games in a row, they scored more runs than the York Yankees, and that's an observable empirical fact.
 - Q. Sir, you're a cell biologist?
- A. That's correct, sir.

- 1 Q. I think you indicated you weren't an evolutionary 2 biologist?
 - A. That is correct, sir, I am certainly not trained as an evolutionary biologist.
 - Q. Not trained as a philosopher of science?
 - A. That is correct.

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- Q. Nor trained as an expert in theology?
- A. That is correct.
- Q. Nor an expert in mathematics?
- A. That is also correct. I've taken courses in
 mathematics. I use mathematics in my teaching and in my
 research, but I would never qualify myself as an expert
 in mathematics.
 - Q. I believe you never taught a 9th grade biology class, is that correct?
 - A. Actually, I have taught a few 9th grade classes, but I assume you mean serving as a regular teacher for an academic year, and, no, I have not done that.
- 19 Q. You obviously consider yourself to be a 20 scientist?
- 21 A. Yes, sir, I do.
- Q. Would you agree that any person that's trained as
 a scientist should have an understanding of what
 qualifies as a science and how the scientific method
 works?

- 1 A. Yes, think I would agree with that.
- Q. In that respect, because you are a scientist, you believe you're qualified to give an opinion on what is and what is not science in this case?
 - A. I think that most members of the American scientific community would have -- would be qualified to give opinions on what is and what is not science and, therefore, I would agree with what you just said.
 - Q. And a biochemist is a scientist?
- 10 A. Oh, of course.

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- Q. I think we've already identified Dr. Behe as an professor of biochemistry at Lehigh University, is that correct?
- A. I believe that's exactly how I identified him,

 15 correct.
- 16 Q. And you would consider him a scientist?
- 17 A. Of course I would.
- 18 Q. And he's a member of the scientific community?
- 19 A. Absolutely.
- 20 Q. A microbiologist is a scientist?
- A. Yes, sir. Yes, sir, microbiologist is a scientist.
- 23 Q. Dr. Scott Minnich, you know him?
- A. Yes, I have met Dr. Minnich.
- 25 Q. He's a professor of microbiology at Idaho

University or University of Idaho -- excuse me?

- A. Yes, University of Idaho, that is correct, and he is a professor of microbiology there.
- Q. He's a scientist and a member of the scientific community, you acknowledge that, right?
 - A. Yes, sir.

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- Q. Sir, as an initial matter, you have no objections to the Dover Area School District putting Of Pandas and People in the school library, is that correct?
- A. Well, it's an interesting question. I certainly am someone who believes that libraries should be open places, and I personally believe that the people of Dover and your elected representatives on the board of education are charged with determining what books should be in the library at Dover. So I am not about, as an individual, to make certain statements as to what books do or do not belong in that library. I think that's a decision for the people of Dover and their elected educational representatives to make.
- Q. Similarly, sir, you have no objections to this book being referenced in a 9th grade biology class?
- A. Well, sir, it depends upon the nature of the reference. And again, when you say, you have no objection to it, I think that this pre-supposes that I am somehow taking it upon myself to tell the educators

in Dover how they should reference or how they should conduct themselves.

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I certainly, for the purposes in my earlier testimony, regard this book, Of Pandas and People, to be filled with shotty science, with misrepresentations of science, to contain serious scientific errors. And I would certainly not advise any person engaged in scientific education to use the book that was laid with errors and misrepresentations as part of their curriculum.

So my advice, if I were asked, would be not to.

When you say, would I object, I don't think the decision is a -- one in which I, as a resident of Massachusetts, have any right to object, as you put it, to the decisions that are made in Dover by the elected representatives of the people of Dover. Therefore, I don't object. But if I were asked for my advice, that's what my advice would be.

- Q. And you acknowledge that the board of education that makes those sorts of educational decisions for the school districts?
- A. It certainly, in the state in which I live, such decisions are made by the board of education and by their professional, their selected professional agents, such as superintendent of schools and so forth, and I

assume that in the State of Pennsylvania, things work pretty much the same way.

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- Q. Sir, the Pennsylvania State Academic Standards require students to, quote, evaluate the nature of scientific and technological knowledge, unquote. You have no objection to that standard, do you?
- A. Oh, not only do I have no objection to it, I think that's a good standard. I think students should do that.
- Q. Similarly, the Pennsylvania State Academic Standards require students to, quote, critically evaluate the status of existing theories, unquote. And they include in the list of examples five different theories, one of them being the theory of evolution. Do you have any --
- A. Would you be kind enough to tell me what the other theories are, sir? I'm sorry to slow you down,
 Mr. Muise, but I always find the context of a statement is useful in helping to formulate a complete answer.
- Q. Just so the record reflects, I'm reading from Defendant's Exhibit No. 233, the academic standards for science and technology and environment and ecology. It says, critically evaluate the status of existing theories (e.g. theory of disease, wave theory of light, classifications of subatomic particles, theory of

evolution, epidemiology of AIDS)? Thank you for reading that to me. I do appreciate it. So it does not say, as I understand your reading of it, that students shall evaluate these particular theories. It says that students shall evaluate all theories, and it lists a number of theories as examples of the theories they should critically evaluate. And in that context, I think that's a very, very good educational policy, and I would endorse it. Q. You don't have a problem that they listed the theory of evolution amongst the list of the five that they included? A. No, sir. And I also have no problem that they listed the wave particle duality of life. I think that's also worth critical examination. Q. You've written several articles addressing, I quess, what's been described as the biological challenge to evolution? A. Yes, yes.

Q. And essentially disputing the concept of irreducible complexity, as we heard earlier today, is that correct?

A. That's also correct.

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Q. You wrote an article that was entitled The Flagellum Unspun?

A. Yes, I did write such an article.

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- Q. And that appeared on your website. You have a personal website at Brown University, is that correct?
- A. That's correct. When I wrote the article, I put a preliminary draft of that article up. It's -- I think it's got a couple of typos and spelling errors. And then I sent it off for inclusion in a volume which has since been published. But that was a first draft of the article which is now in print.
- Q. In that volume in which the article was published, what was it?
- 12 A. Well, I have to confess. I'm going to ask for your help here. There were two volumes which I 13 14 contributed sort of essays to. One was edited by Neil 15 Manson. Another one is edited by, I think, William Dembski and Michael Ruse. And I honestly cannot 16 17 remember to which of those I sent The Flagellum Unspun. 18 If you could refresh your memory, it would be very 19 helpful.
 - Q. Do you believe it could have been from Debating Design from Darwin to DNA, edited by William Dembski?
 - A. I believe it could have been that one, and I'm sure you have it in front of you, so if you've got it, I certainly would agree.
 - Q. Now that book, Debating Design, it was edited by

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    William Dembski and Michael Ruse, correct?
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           That's my understanding.
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           William Dembski is a proponent or advocate of
       Ο.
    intelligent design?
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           That's also my understanding.
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           Michael Ruse is a philosopher of science?
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       A. Yes, I think that's right. I think Michael is a
    philosophy of science at the University of South
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    Florida, Tampa -- or Florida State. He'd be furious if
    I got the institution -- I'm sorry. I meant to say,
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    yes, to your question.
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       Q. He's an opponent of intelligent design, is that
    correct?
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           Yes, sir, that is correct.
           You know Michael Behe also contributed an article
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    to this particular book?
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       A. Yes, I believe Dr. Behe wrote an article, too.
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           His article was addressing similar topics that
    you addressed, this concept of irreducible complexity?
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       A. Yes, it was.
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           And Debating Design was published by Cambridge
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    University press, is that correct?
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       Α.
          I think that's right.
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       Q.
           That's an academic press?
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          Yes, it's an academic press that I believe is
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owned by Cambridge University in Great Britain.

- Q. In that article that you wrote, Flagellum Unspun, were you, in effect, disputing Dr. Behe's claims using scientific evidence?
- A. Yes, sir, I was. I examined the thesis that Dr. Behe put forward in his book, Darwin's Black Box, and I subjected that thesis to analysis by reference to other research material, results from other laboratories, and I basically showed how, in my opinion, Dr. Behe's ideas were mistaken.
- 11 Q. And Dr. Behe's article, obviously, had different 12 conclusions than what you reached?
- A. Yes, I think that's only fair to say, he reached different conclusions than I did.
 - Q. You also wrote an article called Answering the Biochemical Argument from Design?
- 17 A. Yes, I did.

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- Q. That one also appears on your personal website at Brown University?
- A. Yes, sir, it does. I also, as I did with the first article you referenced, I wrote a rough draft of that article, and when I sent it to the editors of the volume, in this case I think the editor was Neil Manson, I put that rough draft up on the website so that people could see it and read it.

- Q. Again, that article you relied on scientific evidence to challenge Dr. Behe's ideas?
- A. Yes, sir, I did. In many cases, I relied on Dr. Behe's own examples and arguments to show why I thought these ideas were incorrect.
 - Q. You've authored a book entitled Finding Darwin's God, is that correct?
 - A. Yes, sir, that's right.

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- Q. You dedicated a chapter in that book, I believe it's chapter 5, God the Mechanic, to again expressing the scientific evidence, demonstrating the scientific evidence refute Dr. Behe's claims, is that right?
- A. In chapter 5 of that book, which is subtitled God the Mechanic, I examined a number of arguments that are made in favor of intelligent design. Now the book, of course, was written in 1998 and 1999, so the arguments I tried to address were those that I was aware of at the time. And they included Dr. Behe's book, Darwin's Black Box.
- Q. Again you relied on scientific evidence to refute these claims?
- A. Yes, sir, I did.
- Q. Did you know that your book, Finding Darwin's God, is in the Dover High School library?
- 25 A. I have been told that by a number of people.

I've never visited Dover, so I don't have firsthand information of that, but that's what I've been led to believe.

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- Q. Did you know that the statement that you were looking at during your initial testimony, the one read to the students, that it was modified in June to reflect the fact that there were additional materials, different books on intelligent design included in the Dover High School library?
- A. So if I understand your question, sir, you're telling me that there now is a different statement that was modified in June? I am unaware of that statement, and I haven't seen it in evidence, so, no, I don't think so.
- Q. You're unaware of that, if there has been a change in the statement, is that what you're saying?
- A. Well, in this proceeding, the only statement that I have seen that's composed by the Dover Board of Education is the one that was introduced into evidence this morning and I had an opportunity to comment on it. If there is another statement, I have not seen it.
- Q. Now your testimony today appeared to be similar to many of the arguments that you presented in those articles that we just addressed, The Flagellum Unspun, Entering the Biochemical Argument from Design, and in

your chapter 5 Finding Darwin's God. Is that a fair assessment?

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A. I think it's a fair assessment to say that what I testified about today was similar to many of those things, but quite a few parts of it were really quite different. Needless to say, the article that I quoted that it appeared in, in Nature magazine four days ago certainly wasn't in any of those. Neither were the new biochemical results from Jiang and Doolittle and other researchers on the blood clotting cascade. Neither was the evidence on the evolution of VDJ recombination systems.

So I think to be perfectly honest and to be fair and reasonable about this, a great deal of what I testified about this morning was not in any of those articles or in any of my earlier writings or presentations.

- Q. You debated Dr. Behe and others in various forums debating intelligent design, is that correct?
 - A. Yes, that is correct.
- Q. You debated Dr. Behe and Dr. Minnich at Concordia College in Wisconsin in 2002, is that correct?
 - A. That's my recollection as well.
- Q. You debated Dr. Behe and Dr. Dembski at the
 American Museum of Natural History in New York somewhere

in 2002, 2003, is that correct?

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- A. Yes, but to complete the record on that point, although in Concordia, I debated Dr. Minnich and Dr. Behe at the American Museum of Natural History program you're talking about, the evolution side, if you will, was represented by myself and by Robert Pennock of Michigan State University in addition to the two gentlemen you mentioned on the intelligent design side.
- Q. That was the one at the American Museum of Natural history in New York?
- 11 A. Yes, sir, that was.
- Q. During these debates, you were presenting your scientific argument against intelligent design, and Dr. Behe was presenting his scientific argument in support of intelligent design?
 - A. Absolutely.
- 17 Q. You also debated Dr. Behe at Haverford College in 2002, is that correct?
- A. To an extent, yes. I believe, and I'm sure Dr.

 Behe will agree with this when he takes the stand later

 in the trial, that was not so much a debate as a

 sequence of presentations. And Dr. Behe made a

 presentation, I think, of 20 or 25 minutes, and then I

 followed it with a presentation of 20 or 25 minutes of

 my own. We didn't have the sort of back and forth that

one characterizes as a debate. But otherwise, yes, that's correct.

- Q. It was a presentation something similar to what we saw today with the slides and the discussion of scientific evidence. You advancing your claim and Dr. Behe advancing his claim?
- A. The presentation certainly did include slides. Being a microscopist by training, somebody who takes pictures for a living, I find myself incapable of talking without slides. So therefore, I certainly included them. And I made arguments based on the scientific method.

But once again, a great deal of what I brought to the Court's attention this morning simply did not exist back when we had this little discussion at Haverford College.

- Q. You agree Dr. Behe will have probably a point by point opposition to the evidence that you presented previously and the new evidence that you presented today?
- A. I actually wouldn't want to speculate on Dr.
 Behe's testimony.
 - Q. Has that been the practice of your prior debates, you put up your scientific evidence, then Dr. Behe will put up his scientific evidence, demonstrating the

support for each of your claims?

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- A. I suppose that's a fair summary of any debate, which is that each side tries to marshal the evidence and the arguments that are in favor of their side.
- Q. And Dr. Behe was relying on scientific evidence, correct?
- A. Dr. Behe certainly relied on elements from the literature, from the scientific evidence. It's important to understand that scientific evidence, factual evidence, as I mentioned earlier, are isolated things. There's a fact here and a fact there. How you tie them together is really what the practice of science is all about.

In these discussions and debates, it's my recollection -- and there have been a lot of them. We've had a lot to say to each other.

- Q. So you have a cottage industry going here between the experts?
- A. I don't know if it is a cottage industry or not, but certainly Mike and I see each other quite a quit. I think it's fair to say that he relies on certain elements of scientific fact to marshal his arguments.

 And the point that I think is relevant is basically that he makes, in his books and his writings, and he makes in these debates, a large number of claims regarding

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irreducible complexity, regarding the biochemical
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    argument from design that have been repeatedly falsified
    by experiments, by observations in nature, and that's
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    the point that I try to make in these debates, that
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    these claims have been examined, considered by the
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    scientific community, and generally falsified.
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           He disagrees with you?
       Ο.
           I'm sure that he disagrees with me, but, of
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       Α.
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    course, he'll get a chance to say that himself, and I
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    wouldn't want to speculate. Perhaps he'll get up here
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    in a couple days and say, you know, I listened to
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    everything Dr. Miller said and, by God, he's got it
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    exactly right.
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                THE COURT: We'd have a real story then,
    wouldn't we?
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                THE WITNESS: Exactly.
                MR. MUISE: I doubt that will happen.
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    BY MR. MUISE:
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           Do you think that will happen, Dr. Miller?
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       Α.
           I'd much rather make a bet on the outcome of the
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    world series this year than to make that kind of bet.
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           That's probably a safer bet. And Dr. Minnich
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    doesn't agree with your conclusions regarding the
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    biochemical challenge to evolution, correct?
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       A. Well, once again, I would be inclined to let Dr.
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1 | Minnich's testimony speak for itself when it comes.

I've -- I believe I've only met Dr. Minnich once, and that was at the discussion at Concordia College that you mentioned, which is probably three or four years ago.

And I honestly don't know how Dr. Minnich's views on this subject have been changed by research that happens in science over the last several years. And I would look forward to hearing them if I happen to be in town or I look forward to reading them if I have access to the transcript of the trial. But again, I wouldn't speculate on what Dr. Minnich will say.

- Q. Now you debated Dr. Behe and others on the Firing Line with William F. Buckley, correct?
 - A. That's correct.

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- Q. And I believe you indicated during your deposition that Mr. Buckley took the side of Dr. Behe in that debate?
- A. Yes, I think I said that. This was a debate on the PBS program called Firing Line, and the title of the debate, I think, is important to understand. The title of the debate was resolved. The evolutionist should acknowledge creation. It wasn't acknowledge design. It was acknowledge creation. So on the creation side were Dr. Behe, a writer named David Berlinski, a law professor at the University of California named Phillip

Johnson, and William F. Buckley.

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On the side defending evolution were myself,

Eugene Scott from the National Center for Science

Education, Barry Lynn from Americans United for

Separation of Church and State, and Michael Ruse, the

philosopher whom you've already made reference to as the

editor of one of these volumes.

Again, the subject of the debate was that evolutionists should acknowledge creation.

- Q. In addition to the articles that we've mentioned previously and the public debates, you debated Dr. Behe in print in Natural History magazine, is that correct?
- A. Yes, that is correct.
 - Q. And I believe he contributed a one page article, and then you have had an opportunity to rebut that article without him having an opportunity for a reply, correct?
 - A. Well, I think it would be useful to the Court to describe that issue of Natural History magazine more fully, more completely. And my understanding was that the editors of Natural History decided that there was enough interest among the readership in this idea called intelligent design that what they invited three leading proponents of intelligent design to do was to take a full page of Natural History, unedited, say anything

they wanted, and they then invited three scientists to respond.

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The three people they invited, I believe, were Dr. Behe, William Dembski, and Jonathan Wells. All three of these people in addition to their other positions are, I believe, senior fellows of the Discovery Institute in Seattle, Washington. They then asked three scientists to respond to each of those.

So, yes, that's right. Dr. Behe's essay was given to me, and I had a certain space to respond to it, and that's exactly what I did.

- Q. These articles in this magazine are sent out for scientific review, is that correct?
- A. Well, actually, Natural History is not really a scientific journal. It deals with scientific topics. And certainly the editorship is concerned with scientific issues, but the whole format and the premise of this point, counter point in Natural History was to take three people who were known as leading advocates of intelligent design, let them have their best shot, and the only editing that I'm aware of that was done was copy editing, trying to make sure it would fit in the space, not scientific review, not peer review.

And I certainly know that my response to it was handled in exactly the same way, that my copy was edited

so that it would fit, and so that it was relevant in terms of rely to what Dr. Behe wrote, but my copy, and I think Dr. Behe's copy was not sent out for peer review in the ordinary sense of a scientific paper.

- Q. You also wrote an article called Life's Grand
 Design that was published by MIT in Technology Review
 Magazine?
 - A. That is correct.

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- Q. And this article dealt with some of the aspects of the intelligent design argument, is that correct?
- A. Yes, this article was solicited by the magazine technology review after I gave a presentation on the evolution creation controversy, I think at the AAAS, American Association for the Advancement of Science meetings in 1993.

And they asked me if I would write an article about the emerging intelligent design movement. I wrote this article called Life's Grand Design in 1994, and just to refresh your memory about the testimony this morning, 1994 was before I had met or heard of Dr. Behe, before I had seen the book Pandas and People, before Dr. Behe's book, Darwin's Black Box, was published, and before I participated in any other debates with respect to intelligent design.

Q. I believe you testified in your deposition that

this magazine is one that is intended for the scientifically literate, but not necessarily considered a scientific journal, is that correct?

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- A. Yes, I believe that's correct. I believe, in essence, Technology Review is almost the alumni magazine of the Massachusetts Institute of Technology. It is a sent to MIT alumni, and it concerns itself with discussion of issues of science and technology that presumably are of interest to graduates of that university.
- Q. Is there a hard and fast definition between what is scientific journal and what is a journalistic publication about science?
- A. I think the honest answer to that question is, not a hard and fast definition. But basically, a scientific journal in the more general sense is a journal that publishes the original results of scientific investigation, experiments, materials and methods, techniques, and presents original, never-published-before scientific data.

In fact, a scientific journal of the sort that I have edited, such as the Journal of Cell Biology, actually has a rule, and that is that, you cannot send into that journal any results from any experiment that have been published anywhere else before.

So we want only original micrographs, original gels, original DNA sequences, original experimental results. Some of the other journals that have just now come up in the discussion, Natural History magazine, Technology Review. And let me pick a couple of other journals that are well-known. Scientific American, Discover magazine are journals or magazines that publish science, but they don't publish original scientific work.

They're not subject to peer review in the usual fashion. And, therefore, if one had to make a rigorous definition of whether or not those are scientific journals, the answer would be, no.

- Q. Now, sir, you testified about peer review in the sense you are referring to it as a staple of science, correct?
- A. Yes, I did.

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- Q. Is there a time when peer review became that, a staple of science?
 - A. Well, you know, you're asking for more in the history of science than I really find myself qualified to answer. And I'm not really a historian in the history of science. But what I can tell you is that, certainly during my entire lifetime -- I was born in 1948 -- the scientific journals that I referred to as

leading scientific journals, Proceedings of the National Academy, Nature, Science, all these journals have existed.

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They have all used a peer review process very similar to my description. And, therefore, the top scientific journals within my entire lifetime have all used essentially the peer review process that I described in my testimony earlier today.

- Q. Well, prior to the adoption of this peer review process, you would agree that what scientists were doing was still science?
- A. I think there are many ways and many forms to do science. But peer review in the formal sense of how an article gets into a journal today in many respects did not really exist; for example, in the 19th century when the institutions of science were just beginning to be developed.

But it's important to appreciate as well what peer review actually means. And what it means is subjecting your scientific ideas to the open scrutiny and criticism of your colleagues and competitors in the field. That has always been part of science, certainly well into the early part of the 19th century.

Q. In terms of the modern description of this peer review, none of that standard, Darwin's Origin of

Species wasn't a peer reviewed book as well?

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A. Well, first of all, books are rarely peer reviewed today, yesterday, ever. For example, when I wrote Finding Darwin's God, I did what a lot of writers do, and I bet ya what Dr. Behe did when he wrote Darwin's Black Box, which is, I thought about a book I'd like to write.

I put together a proposal. I circulated a proposal to a few publishing houses hoping I could find an editor and a publisher who was interested in it. And when they were, we sat down, signed a contract. I got very excited, sat down and wrote the book. The sort of review that went into that book was interaction between me and an editor, me and a copy editor, and finally myself and a fact checker. And I bet ya the same process went into Dr. Behe's book.

That doesn't qualify as peer review any under circumstance. Now you raise the specific example of a book written by Darwin, called the Origin of Species.

And I think it's important -- again I'm not a historian of science. I'm a real amateur here. My understanding of how the ideas in that book were developed was that, Charles Darwin wrote many letters, essays, and small articles which were read before the royal society in London.

The discussion and criticism of those individual letters which were read was a normal part of the scientific process in Great Britain in the 1840's and 1850's. So that most of the ideas that Darwin incorporated in the Origin of Species actually had been subjected to something that today we would recognize as peer review, which is advice, criticism, analysis, critical analysis by one's colleagues.

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The publication of that book, was that a peer reviewed publication? Of course not, for the reasons I've given. Were Darwin's ideas themselves subjected to peer view? The answer is, as it existed in the 1840's and 1850's, yes.

- Q. You testified you wrote a critique of Dr. Behe's book, Darwin's Black Box, is that correct?
- A. Yes, after his book was published, I believe I wrote a critique of it, and then I subsequently posted that critique for public inspection on the Internet.
 - Q. That was a scientific critique of his book?
- A. Well, it depends in what sense you mean scientific. The issue, my critique of the book was based on my understanding of the scientific literature and scientific fact, so it certainly was a scientific critique as opposed to, let's say, a grammatical critique or literary critique, neither of which I would

certainly be qualified to do.

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- Q. And I believe Dr. Behe has responded to his critics in various articles and publications?
- A. Well, my understanding is that, at the website of the Discovery Institute, there is an article that I've seen once or twice called a Response to My Critics, written by Michael Behe. If that is what you're referring to, then my answer is, yes.
- Q. Is that the only publication that you're aware of where he's defended his arguments?
- A. No, I don't think so. I think the Discovery
 Institute routinely publishes comments by their fellows
 on a variety of issues, and I'm sure that -- I'm not
 aware of all of them -- but I'm sure that Dr. Behe has a
 large number of articles that have been posted there on
 the web, and he may have published a few such responses
 in various magazines and popular media that I'm not
 aware of, and I'm sure they're out there.
- Q. One of them being, for example, Debating Design, the same book that you contributed an article?
- A. Well, certainly Dr. Behe had an article in Debating Design. That's a question you've already asked me, and I've already answered. I'm sure that Dr. Behe in that article addresses many of the criticisms of his ideas.

- Q. Sir, I believe you indicated falsifiability is a factor you consider to determine whether something is science?
- A. I think -- I believe what I said is that, in order to qualify as a scientific theory, the scientific theory must make predictions which lead to testable hypotheses.
 - Q. If you can falsify it, it's a scientific theory?
- A. If you can falsify it, it's a scientific theory?

 I'll repeat what I said, because I think that was an answer to your question. That is, a scientific theory should lead to the generation of testable or falsifiable hypotheses. So if a theory does not and cannot lead to the generation of falsifiable hypotheses, it doesn't qualify as a scientific theory.
- Q. Now, sir, as a cell biologist, you engage in laboratory experiments?
 - A. Yes, sir, I do.

2.1

- Q. You don't have occasion though to apply natural selection to your experimental work, is that correct?
- A. In the sort of work that I do in the laboratory,
 I do not directly do experiments based on natural
 selection. But it's also fair to say that several of my
 scientific papers have been undertaken precisely because
 I wanted to examine organisms which were related to

other organisms in an evolutionary sense and, therefore, some of my work has indeed had evolutionary implications.

2.1

- Q. I just want to make clear, with regard to the mechanism of natural selection, that's not something that you actually apply hands-on in any of the experiments that you do?
- A. It is fair to say that I have never carried out with my own hands and in my own research area an experiment to test the mechanisms of natural selection, that is correct.
- Q. Now a technique used by molecular biologists is known as the knock-out technique, correct?
- A. Yes, I'm aware of a technique known as targeted gene replacement, which is popularly called the knock-out technique.
- Q. One classic way to understand the importance of a particular component of a system is to take that component away and see how the system works?
- A. Yes. As a matter of fact, it's a very useful technique. So if one has a gene and wants to know how important it is to function, what one can do is to engineer a targeted gene replacement, a knock-out, and then generate embryonic stem cells this is often done in mice and those embryonic stem cells are then fused

into an existing embryo.

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You then, hopefully, grow up a mouse in which there's a patch of cells that has the targeted replacement. You find a mouse -- sometimes it takes a while -- in which these targeted replacement cells are in the gonads, in the reproductive organs.

So hopefully, you've generated a male mouse in which you have the targeted replacement in the testes, a female mouse in which you have a targeted replacement in the ovaries. You cross them. Then you get an offspring in which both genes have been knocked out. And then you can study the effect of losing that gene.

- Q. Obviously, that's a legitimate technique employed by scientists?
- A. Of course, it's a legitimate technique. It's a tool and technique that's often used -- it's a technique that is tricky because completely knocking a gene out can sometimes have unexpected implications. You have to interpret it carefully. But it's used all the time in research laboratories around the world.
- Q. So you would agree that the cell is a collection of protein machines?
- A. Would I agree that the cell is a collection of protein machines? I would agree that the cell contains a great many protein machines. It has a collection of

them. It's also a great deal more. It's also a collection of complex carbohydrates, lipids, membranes, compartments, barriers, ionic radiants. But, yes, I would agree the cell also contains a collection of protein machines.

2.1

- Q. Scientists refer to individual proteins or collections of proteins as being part of the DNA replication machinery, the proteins synthesis machinery, and the ion transport machinery, is that correct?
- A. It is very common in molecular and cellular biology to use the term machine as a figure of speech to reflect a shorthand to a number of proteins that act together for a particular purpose.
- Q. Well, these number of proteins acting together for a particular purpose actually operate like machines that we could recognize in the human world?
- A. Well, only by analogy. And what I mean by that is, let's take a machine called dynein. Dynein is often called a molecular motor. It generates force. It's a very large, very complicated protein that has basically two heads on it.

And the dynein heads will interact with other proteins. Dynein, in effect, in a molecular level looks almost like a large blob with two legs. If I can draw your attention to the front of the podium up here.

Dynein will make an interaction with one compound, and then random molecular forces will wave the rest of it back and forth until it makes another connection. This will then release.

2.1

It will wave back and forth and make another connection. So, as a cartoon image, dynein almost looks like somebody walking. I'm not really aware of any machine that actually works by that particular mechanism. But we nonetheless refer to dynein as a molecular motor or molecular machine because it's a very useful figure of speech, a kind of shorthand to remind of what it does. In the case of dynein, it generates force and movement.

- Q. Don't we regard the protein as a collection of interacting parts in a way that is similar to the machines that we understand the world today?
- A. I'm sorry. Did you say, can we regard proteins --
- Q. As a collection of interacting parts?
 - A. Not always. Proteins are compounds that are built out of polypeptides. And there are small and simple proteins like insulin, for example, that has only 60 or 70 amino acids, which is really -- an insulin is really not a collection of individual parts. It's one coherent part.

There are other more complex proteins. For example, the C3 component of compliment that I mentioned near the end of my testimony this morning, is a complex protein that's made up of individual segments or modules that arose by gene duplication. And in that respect, those individual segments or modules quite clearly are parts, all of which work together to make the concerted function of the machine possible. Is that a complete answer to your question, sir?

2.1

- Q. I guess they use the term machines because it's a metaphor that makes it as closely replicated to what we understand as machines? Is that the utility of that metaphor?
- A. Yes, I think the utility of the metaphor is that we think of the machines that we build in the human world as composed of a number of parts to achieve a particular end. In the cell, certainly. There are many assemblies of proteins and other components where the parts interact and a particular result comes out of this.

And the metaphor of the machine or the metaphor of the motor that I just mentioned or the metaphor of the pump or the metaphor of the copying machine is often used in biology just as a shorthand to help us remember what these individual components do.

- Q. Bruce Alberts, he's the president of the National Academy of Scientists, is that correct?
 - A. No, it's not. Bruce is no longer the president of the National Academy of Sciences because his term has expired.
 - Q. When did his term expire?

2.1

- A. A couple months ago. Dr. Alberts is the outgoing -- it's all right. Alberts is the outgoing president of the National Academy of Sciences and a very, very highly respected molecular biologist.
- Q. And he wrote an article that referred to protein to molecular machines, correct?
 - A. He wrote an article in the journal Cell called Educating the Next Generation of Cell Biologists. And that was subtitled, The Cell is a Collection of Protein Machines. And I might add, I find that to be a useful and valuable article, and I often assign it to the upper level students in my cell biology course.
 - Q. In that article, he suggests that the new modern biologist ought to take courses in engineering so they can understand the intricacies of these machines that we find in the cell, correct?
- A. He does indeed make that suggestion.
- Q. Sir, would you agree that science involves a weighing of one explanation against another with respect

to how well they fit the facts of experiments and observations?

2.1

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- A. I would agree that science involves the weighing of one natural explanation against another with respect to how well they fit, the results from observation and experiment.
- Q. Would you agree that all science consists of looking at the evidence and then drawing inferences from it?
- A. I think that part of science is looking at the evidence and drawing inferences, but I hesitate to agree completely with your question because I certainly think that drawing just any inference from data is not necessarily scientific.
- Q. I believe in your deposition, one of the examples we used in defining science the way that I just asked you that question was paleontology, correct? Do you recall?
- A. To be perfectly honest, I'm sure you're right.

 But I can't remember -- the deposition went on for nine

 and a half hours. And to be perfectly honest, there are

 parts of it I have forgotten. But I'm willing to agree

 that, yes, it probably did deal with that.
- Q. Paleontology is a science which consists of looking at the evidence, the observable evidence, and

then drawing inferences from that evidence?

2.1

- A. It consists -- paleontology consists of looking at the accumulated evidence of past life and then applying the scientific method to make scientific testable inferences, if possible, about the nature of life in the past and also about the nature of biological change.
- Q. I believe you testified previously that science doesn't prove things, is that correct?
 - A. Yes, I believe I did say something like that.
- Q. Is it accurate to say that science disproves things?
- A. But science does disprove things. And, in fact, an essential element of the scientific process is this is why the testable hypothesis is so important. A theory is not a useful theory unless we can generate it from generate from it testable hypotheses. And science will occasionally disprove those hypotheses.

And I mentioned earlier, I think I mentioned rather briefly, that the most popular hypothesis as to how amino acids are joined together inside the ribosome which has been that ribosomal RNA acts as a ribozyme, an acid based catalyst, to put those together. Now looks as though it's been disproven by experiments that I mentioned before that were done by Al Dahlberg at my

university.

2.1

That's a classic case of a really, really useful testable scientific hypothesis whose disproof leads us, hopefully, in a more productive direction. So in a few years, we'll find out what the real chemical mechanism is of bond formation.

- Q. Sir, during your direct testimony, you discussed the term evolution as having sort of different meanings or can be used in different ways, correct?
- A. Yes, I did. And I believe that -- and I'm sure you'll correct me if I don't have this quite right. I believe I pointed out that the word evolution in English is often used to refer to two quite different things. Sometimes the word evolution is used to refer to what happened in the past; namely, the life of the past changed into the life of the present.

And we regard evolution simply as the record of change in natural history. I think more commonly in the context of the proceedings in this courtroom, what we mean by evolution is evolutionary theory, which are the mechanisms which actually drove that change and changed the life of the past into the life of the present.

So I certainly did point out those two quite different meanings of the word evolution.

Q. In the first meaning, is it proper to say it can

be regarded as a historical fact?

2.1

- A. I certainly regard the record of life in the past as historical fact. And I think the science of geology, by using the testable principles of natural science, has established that the earth is old, that the geological ages are authentic, and that the pattern of life's change that we see is a factual pattern. So I think, yes, I generally agree with your question.
- Q. Evolution in the second sense is where evolution is a theory, correct?
- A. That is correct. And evolution is a theory in that it unites a whole series of mechanisms in terms of an effort to try to explain the process of evolutionary change that characterizes the natural history of life on earth.
- Q. And as a theory, the theory of evolution is not a fact?
- A. Sir, no scientific theory is a fact. All scientific theories are based and supported by scientific fact. In that respect, evolution is not exceptional.
- Q. Would you agree that Darwin's theory of evolution is not an absolute truth?
- A. I certainly would for the very simple reason that
 no theory in science, no theory is ever regarded as

absolute truth. We don't regard atomic theory as truth. We don't regard the germ theory of disease as truth. We don't regard the theory of friction as truth.

2.1

We regard all of these theories as well-supported testable explanations that provide natural explanations for natural phenomena.

- Q. Included in that list would be Darwin's theory of evolution?
- A. I think you've already asked that and I've already answered that. The theory of evolution is not exceptional. It is a scientific theory, like the other scientific theories I have mentioned.
- Q. Darwin's theory of evolution continues to change as new data are gathered and new ways of thinking arise?
- A. I would agree that all scientific theories continue to change as we advance in our understanding of science and as we accumulate scientific knowledge. And once again, the theory of evolution is not exceptional in that respect.
- Q. Because Darwin's theory is a theory, it continues to be tested as new evidence is discovered?
- A. No, that's not quite right. All scientific theory is subject to testing as new evidence is discovered. So to say, because it is a theory, it continues to be tested, really misstates the scientific

- status of evolution. Everything in science is subject to testing. Everything is subject to revision.
- 3 Everything in science is subject to critical analysis.
- 4 And evolutionary theory is no different from that.

2.1

- Q. What about evolution in the first sense, the historical fact? Does that continue to be tested as new evident is discovered?
- A. We always in science continue to examine to see if facts are really factual. And one of the statements that I was asked to comment on this morning is that, very often facts in science change and theories don't. And that sounds paradoxical.

But what it means basically is, if we have a factual observation, for example, one of the fossils that was discovered in the Burgess Shale, which is a very famous fossil formation in British Columbia, which is part of the Cambria, one of the fossils was once regarded by Alexander Walcott, who discovered the Burgess Shale, as an entire organism. He classified it, and I believe Walcott might have even created an entire phylum, which is a major category to put this organism in.

Later on, more careful investigators, notably Simon Conway Morris, who's a British paleontologist, went back to the museums. They looked at the same

fossils, the same facts, and they discovered that what Walcott thought was a whole organism was, in fact, the leg of another organism.

2.1

And, therefore, this particular fact turned out not to be correct and the fact had to be revised. All of it nonetheless still fit into the framework that the animals of the Cambrian are well represented in the Burgess Shale. They turn out to be the ancestors of the animals around today. And they represent a variety of unique biological forms.

So when you place particular emphasis on the testing of Darwin's theory of evolution, I would point out that facts in science change well, as well, and that everything we do in science is subject to revision and to change as we get better data and as we go back and we re-examine what we thought were facts in the past.

- Q. So it's accurate then to say, Darwin's theory continues to be tested as new evidence is discovered?
- A. Sir, it is accurate to say that all scientific theories continue to be tested as new evidence is discovered and all scientific facts are subject to examination as well.
- Q. And Darwin's theory being included in that list of all scientific theories?
- 25 A. As I testified earlier, Darwin's theory is not

exceptional in that regard.

2.1

- Q. Sir, isn't it true that all of science is filled with gaps in a sense that scientists fill with unanswered questions using gaps as an unanswered questions as a definition of gaps?
- A. If you define an unanswered question as a gap, then it certainly is true, that science itself is filled with unanswered questions. And that includes not just biology, but includes, for example, physics where there are enormously unanswered —— enormous numbers of unanswered questions about the fundamental nature of matter about the gravitational force, about the strong and weak nuclear force, and a whole variety of other issues.

So it's absolutely correct that science is filled with unanswered questions. I have to tell you, sir, that I would not refer to an unanswered question as a gap. I would not say that we have gaps in the theory of gravitation. I would say there are things about gravity we don't understand.

- Q. If we understood gaps to be unanswered questions, is it accurate to say that there are gaps in Darwin's theory of evolution?
- A. Once again, let me reiterate the point here.

 That is, that I do not agree to your substitution of the

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word unanswered question with the word gap. To me, it
makes absolutely no sense. Would I agree that there are
unanswered questions that fall within the theory of
evolution? Yeah, sure, absolutely.
      I'll represent to you I'm reading a statement
from your biology book, and I'm just going to ask you if
this is true. A stew of organic molecules is a long way
from a living cell and the leap from non-life to life is
the greatest gap in scientific hypotheses of earth's
early history. Is that your statement?
   A. Sir, would it be possible for me to see the whole
page and the context in which the statement is made?
  Q. Sir, I'm handing you what's previously been
marked as Defendant's Exhibit 214.
           MR. MUISE: Your Honor, we have additional
copies if you need us to hand them up at this point
or --
            THE COURT:
                       Well, I have one. I don't know
-- I guess I'm the most important person to have one.
                       That's correct.
           MR. MUISE:
            THE COURT: We'll go from there.
            THE WITNESS: I'm sure that's correct, Your
Honor.
            THE COURT: That remains to be seen.
BY MR. MUISE:
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Q. Page 425.

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A. Yes. I'm flipping to it right now, sir. Okay.

And I'll -- I will explain -- I'll try to explain

exactly what I would mean by that sentence. I'll read

it again. A stew of organic molecules is a long way

from a living cell and the leap from non-life to life is

the greatest gap in scientific hypotheses of earth's

early history.

I think in this particular case, the word gap is entirely appropriate because what we're looking for is missing evidence. It's entirely appropriate to refer to missing evidence as a gap. In this particular case, we understand from experiments that have been done in the laboratory how molecules can, to an extent, self-organize and even self-replicate.

But we don't really have an understanding of how such molecules could have gathered together, pulled together the other structures that they need, and to produce a living cell as we understand it today. So I think that is indeed a gap in the sense that we have missing evidence.

And I mentioned earlier that I have gaps in my understanding of my own family's ancestory in the sense that I have missing evidence. I don't know what's there. Now that's a gap in evidence. That's not a gap

in a theory. And I think that's sort of the point that I had been trying to make.

2.1

- Q. So there's no missing evidence in Darwin's theory of evolution?
- A. Okay. Let's put it this way. There are many periods in earth's history where we don't have a complete historical record, just as there are periods in the history of the United States in which we don't have a complete historical record. If one refers to Darwin's theory of evolution by saying, do we have a complete record of biological change in the past, the answer to that is, no.

But in terms of gaps in the theory, again, I
think you're jumping back and forth between the theory
and the nature of the evidence. Is there indeed
evidence that might support the theory of evolution that
we don't have? Yes. But is there a gap in the theory
itself, a gap in the framework of explanation? That's
essentially what I'm saying, no. I don't buy that at
all.

- Q. Should we regard Darwin's theory of evolution as being tentative?
- A. We should regard all scientific explanations as being tentative, and that includes the theory of evolution.

Q. Darwin's theory of evolution is incomplete and unfinished, isn't that correct?

2.1

A. All science is necessarily incomplete. On the day that physics becomes complete, for example, it will be time to close every department of physics in the United States because we'll know everything. I don't expect to see that happen.

But it is a fair statement that all science, including biology, including Darwin's work on evolution or the evolutionary theory, I should say, is necessarily incomplete.

- Q. Is it true that scientists do not know enough about all structures in the cell to describe how they all work or how describe how evolution could have produced each of them by step-by-step Darwinian processes?
- A. Well, you ask a very interesting question. And I, first of all, am going to enthusiastically agree with the first part, which is that scientists certainly do not understand enough about all of the structures in the living cell to understand how they work. That really is the business, my business and the business of Dr. Behe.

Because the answers to that questions are going to come out of genetics -- sorry. They're going to come out of biochemistry. They're going to come out of cell

biology and maybe molecular biology and genetics as well. I'll answer the second part of your question this way.

Until we understand the first part, which is how everything works, we can't even begin to understand how things evolved. So we will have to have an absolute and complete and total understanding of how everything in the cell works before we can even begin to put together an understanding of how it evolved.

Q. So there are open questions there?

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- A. I certainly hope so, because if there are no open questions in my field, I've written my last grant proposal. I don't think so.
- Q. Isn't it true that scientists still debate and touch questions as to how new species arise?
- A. Do scientists still debate such questions such as how do species arise? The answer, sir, is, absolutely. There is general agreement within the scientific community that speciation, which is to say the origin of new species, can be explained by a variety of natural causes.

And several examples of speciation are indeed well-known and well-understood. But as to which of several mechanisms that can actually drive speciation is the predominant one or the most useful one, there is a

lot of controversy within science about that, no question.

2.1

- Q. Scientists still debate the question why species become extinct?
- A. Scientists certainly debate that question. They don't debate the question as to -- well, sorry. Let me sort of strike that and sort of rephrase everything. Extinction, for the most part, is a historical process. It's something that, for most of us, happen in the past. We do have examples of extinction that actually happened in the present time. And sometimes we can see how that's actually happening.

But most often, extinction occurring in the past, in the fossil record, for example, is an event, meaning the disappearance of a particular species, and we don't always know whether that species starved to death, whether it was driven to extinction by a predator, whether it was terminated by disease, whether its habitat was destroyed by earthquakes or volcanic eruptions. And do scientists still debate those issues? Of course they do.

I would point out as an example, a colleague of mine named Bruce McFadden, who is an expert in the evolution of the horse, he works at the University of Florida, he's published a number of treatises trying to

trace the evolution of a horse and trying to focus in on exactly what the forces were that drove most of the historical antecedents of the horse to extinction.

In some cases, he's pinned it down to diet. In some cases, he's pinned it down to habitat loss. In other cases, he's not sure. So that's a long yes to the question you asked.

Q. It's an open question?

2.1

A. There are many open questions in science. There are some examples where we know what drove an organism to extinction. I can give you an example right now.

The passenger pigeon. We killed it. Human beings hunted passenger pigeons to extinction. The same thing with the dodo.

Those are not open questions. Those are closed questions. Are there examples of extinction for which we don't know the answer? The answer to that is, yes.

- Q. So the origin of life is an unsolved scientific problem, is that correct?
- A. I think it certainly is fair to say that the details of the origin of life are unsolved.
- Q. Would it also be fair to say, it's an area where there is little direct fossil evidence?
- A. Well, not entirely, because actually, there is
 fossil evidence when the first living cells appeared on

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this planet. It's about three, three and a half billion
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    years ago. So we do know when the first simple cells
    appeared, and we also know when the first more complex
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    cells, we know when they appear.
           But it's also true that we don't really have
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    biochemical fossils that could have shown the kinds of
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    self-replicating molecules that might have preceded that
    first living cell.
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                THE COURT: Mr. Muise, I'll give you about a
    seven minute warning, unlike the NFL, where you get a
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    little bit more time, and any place you want to wrap up
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    from here on that you think is an appropriate break
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    time, you can do it, because we'll go to that point
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    today. But you can proceed.
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                MR. MUISE: Are we looking for a break for
    the afternoon or for the --
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                           No, for the day.
                THE COURT:
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                MR. MUISE: For the day?
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                THE COURT: For the day.
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                MR. MUISE: I have about four or five more
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    questions in this area. If I can try to get through
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    them, that will be helpful.
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                THE COURT: Absolutely. Sure.
                MR. MUISE: Thank you.
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    BY MR. MUISE:
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- Q. Dr. Miller, the origin of DNA and RNA in the evolution of cells is an unanswered scientific question, is that true?
- A. Certainly. The origin of those compounds is not completely answered. But one of the things that is rather interesting, and the recent work of Stanley Miller, who's done a fair amount of origin of life research, has shown this, is that the current simulations of primitive earth atmospheres, under certain circumstances, can give rise to the nitrogenous bases which are found in RNA.

It turns out to be rather easy in the simulation experiments to produce adenine, and I believe also to produce cytosine, which are two of the bases. Now knowing that doesn't answer the complete question as to how the complete RNA or DNA molecule evolved, but it does show that some of the building parts of it can be produced spontaneously in the laboratory under conditions that simulate the primitive earth.

- Q. That's related in a sense, is it not, to the fact that the origin of life is an unsolved scientific problem? Is that related to the experiments you just described?
 - A. Yes, sir, it is.

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Q. Now there are many scientists who think that

Darwin's original formulation of the mechanism of evolution was either incorrect or incomplete on the basis of much better current information on how genetics, molecular biology, and what is called adaptation actually works, is that true?

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A. Sir, not only is that true, but I'm one of those scientists, and if he was around today, Charles Darwin would be one of those scientists. Darwin, of course, didn't know anything about biochemistry. He didn't know any genetics because genetics hadn't been invented.

And we now understand evolution in much greater detail than Darwin ever could have. So when you say there are many scientists who believe that Darwin's theories had to be, whatever you said, updated and so forth, the answer is, yeah, all of them do. I'm one of them. And so would Charles Darwin if he was around to see it.

- Q. Sir, many scientists would opine that Darwin's ideas about evolutionary change were inadequate on the basis of current discoveries related to genetic recombination, transposeable genetic elements, regulatory genes, and developmental patterns?
- A. No, I wouldn't agree that. You said that many scientists would agree that Darwin's ideas about change were inadequate based on these. Now what Darwin

basically said was that variation appears spontaneously in species. He didn't know where that variation came from.

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And every example that you just cited is an example of where variation could come from. All of these, however, fit within the general framework of evolutionary theory. So I would rather say that Darwin's ideas were incomplete rather than inadequate. Because Darwin was, if you read the Origin of Species in detail, you'll see that Darwin is quite open about not being really sure where variation comes from or how characteristics are passed along from one generation to another.

The fact that we now know where variation comes from and we now know how information is passed along, doesn't mean his ideas were inadequate or -- it simply means that they were incomplete compared to what we understand now. They nonetheless fit within his framework.

- Q. Now during the deposition you gave, Dr. Miller, where you indicated the lengthy deposition, you use the term inadequate. And let me read from page 113. And I can show it to you. Starting on line 21. Now in discussion --
- A. If you would just give me a second to get to page

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- Q. Do you have a copy of your deposition?
- A. I have it right here. Very good. Thank you.
- Q. Starting on line 21, if you could read from the deposition?
- A. Yes. Let's see. What I said in the deposition, starting with line 12 is, quote, Now in discussion of this issue, it is possible to bring in the opinions of many scientists who say that Darwin's ideas about currently -- sorry, that Darwin's ideas about evolutionary change were inadequate on the basis of current discoveries relating to genetic recombination, transposeable genetic elements, regulatory genes, and developmental patterns; therefore, Darwin's ideas need to be updated in view of current discoveries, but these scientists criticisms of evolution would in general not dispute the idea that the mechanisms of evolutionary change which fully understood at the natural level are still sufficient to bring about the change that the evolutionary process requires.
- Q. So your use of the word inadequate, you're saying, in your deposition was not proper?
- A. Well, I'm not saying, sir, that it wasn't proper.

 I'm just saying that today, upon reflection and thinking
 about it, I would prefer incomplete to inadequate. I

read further in my deposition to make the point, which I think is the coherent point, which is to say that all of these ideas, whether Darwin's idea were incomplete, inadequate, half-baked, or however you want to describe them, can nonetheless fit within the general framework of evolutionary theory that he outlined.

That was the gist of this entire statement in my deposition and that certainly would be my testimony today.

- Q. Do you agree that horizontal gene transfer makes it difficult to trace common dissent through micro organisms?
 - A. Oh, I certainly do.

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- Q. That was the studies of Karl Wose, I believe, demonstrated that?
- A. Karl Wose was the first person to successfully demonstrate horizontal gene transfer, the transfer of bits and pieces of DNA from one micro organism to another. And the fact that this mechanism is widespread among bacteria and viruses means that it's very difficult to trace the pathway of common dissent.

 That's true. And that work started with Wose. It's been continued by many others.
- Q. Would you agree that scientists disagree about the relative importance of natural selection, sexual

selection, chance, species, hibernation, and other factors which all influence evolution?

2.1

- A. Yes, sir, I would agree to that. Scientists certainly do disagree about those points.
- Q. These different ways in which different phenomena and nature might be explained?
- A. I suppose the answer to that is, yes. All of the forces that you just mentioned are patterns that relate either to natural selection or to the generation of variation within the species, which are really part of the evolutionary process.

Do all of those processes occur in nature? Yes.

Are they used from time to time to explain various natural phenomena? Yes.

- Q. Could they be considered alternate theories that explain evolution?
- A. No, I don't think so, because I think what you've done, sir, is to cite a number of phenomena and forces. Sexual selection, for example, is not a theory. It's a process. And horizontal gene transfer, once again, is not a theory in the sense of an explanatory framework. It's a process. I think all of these are forces that can produce and rearrange genetic change within the explanatory framework of evolutionary theory.

MR. MUISE: Your Honor, I'll pick up from

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    there tomorrow morning.
2
                THE COURT: All right. I think we've
    absorbed quite a bit of information today. We'll start
3
    again with the witness tomorrow morning at 9:00 a.m.
4
5
    Thank you, Mr. Muise. Thank you to all counsel. Ladies
    and gentlemen, we'll see you tomorrow. We'll be in
6
7
    recess until 9:00 a.m. tomorrow morning. Thank you.
8
                 (Whereupon, the proceeding adjourned
9
                 for the day at 4:30 p.m.)
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7	evidence are contained fully and accurately in the notes
8	taken by me on the within proceedings, and that this
9	copy is a correct transcript of the same.
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11	/s/ Wendy C. Yinger
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